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AERONAUTICS

Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

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Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

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05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE 703

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.

06 AIRCRAFT INSTRUMENTATION 705

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For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

07 AIRCRAFT PROPULSION AND POWER 705

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For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion*.

08 AIRCRAFT STABILITY AND CONTROL 707

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Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space)*.

ASTRONAUTICS

Includes astronautics (general); astrodynamics; ground support systems and facilities (space); launch vehicles and space vehicles; space transportation; spacecraft communications, command and tracking; spacecraft design, testing and performance; spacecraft instrumentation; and spacecraft propulsion and power.

For related information see also *Aeronautics*.

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For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation*.

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For related information see also *04 Aircraft Communications and Navigation* and *32 Communications*.

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For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

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For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

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For related information see also *Physics.*

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74 OPTICS 813
Includes light phenomena.

75 PLASMA PHYSICS 815
Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

76 SOLID-STATE PHYSICS 816
Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers*.

77 THERMODYNAMICS AND STATISTICAL PHYSICS 822
Includes quantum mechanics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer*.

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) N.A.
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 822
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 823
Includes information storage and retrieval technology; micrography; and library science.
For computer documentation see *61 Computer Programming and Software*.

83 ECONOMICS AND COST ANALYSIS 825
Includes cost effectiveness studies.

84 LAW AND POLITICAL SCIENCE N.A.
Includes space law; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 825
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety*, *16 Space Transportation*, and *44 Energy Production and Conversion*.

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences*.

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY 828
Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

90 ASTROPHYSICS 829
Includes cosmology; and interstellar and interplanetary gases and dust.

91 LUNAR AND PLANETARY EXPLORATION 831
Includes planetology; and manned and unmanned flights.
For spacecraft design see *18 Spacecraft Design, Testing and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

92 SOLAR PHYSICS 832
Includes solar activity, solar flares, solar radiation and sunspots.

93 SPACE RADIATION 833
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

GENERAL

99 GENERAL N.A.

Note: N.A. means that no abstracts were assigned to this category for this issue.

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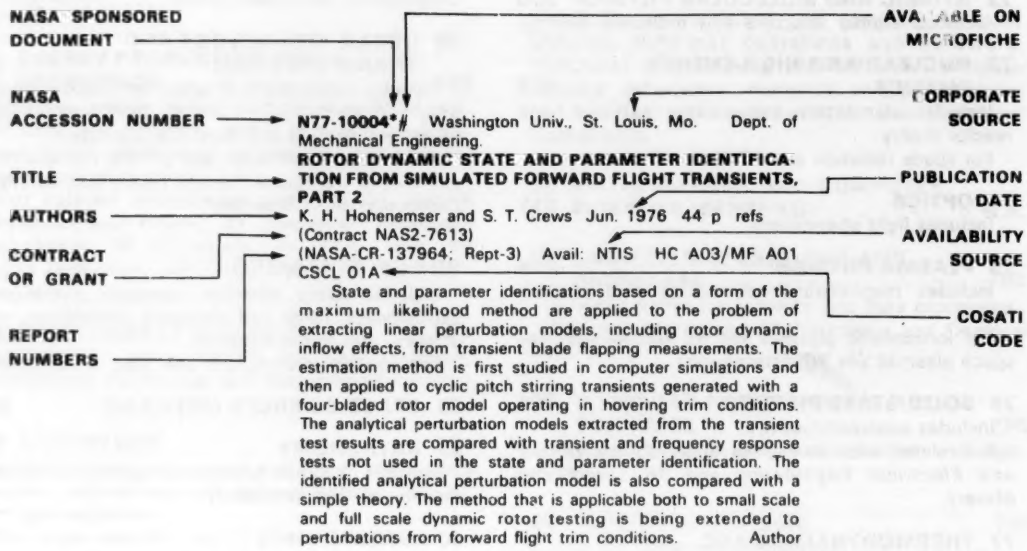
TYPICAL CITATION AND ABSTRACT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ROTOR DYNAMIC STATE AND PARAMETER IDENTIFICATION FROM SIMULATED FORWARD FLIGHT TRANSIENTS, PART 2
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State and parameter identifications based on a form of the maximum likelihood method are applied to the problem of extracting linear perturbation models, including rotor dynamic inflow effects, from transient blade flapping measurements. The estimation method is first studied in computer simulations and then applied to cyclic pitch stirring transients generated with a four-bladed rotor model operating in hovering trim conditions. The analytical perturbation models extracted from the transient test results are compared with transient and frequency response tests not used in the state and parameter identification. The identified analytical perturbation model is also compared with a simple theory. The method that is applicable both to small scale and full scale dynamic rotor testing is being extended to perturbations from forward flight trim conditions. Author

ON-GOING RESEARCH PROJECTS

This is a listing of research projects - not publications

AERONAUTICS

Includes Aeronautics (general); Aerodynamics; Air Transportation and Safety; Aircraft Communications and Navigation; Aircraft Design, Testing, and Performance; Aircraft Instrumentation; Aircraft Propulsion and Power; Aircraft Stability and Control; and Research and Support Facilities (air). For Related Information See Also Astronautics.

1.0001, ADVANCED TECHNOLOGY SERVICING EQUIPMENT FOR ARMY AIRCRAFT
R.R. MEJDRICH, Signal Companies Incorporated, *Phoenix, Arizona* 85034 (DA0D4054; DAAJ02-76-C-0042)

Develop improved aircraft servicing systems and equipment and operating unit ground maintenance capabilities to achieve significant reductions in turnaround time between missions, and improved equipment to enhance required maintenance capability at the operating unit or intermediate support levels.

Contract with qualified servicing and maintenance equipment manufacturers to evaluate, select and develop optimum concepts for improved technology servicing and ground maintenance equipment for use at the operational unit or intermediate support levels.

ADDENDA: Supporting agency address is: AVSCOM Air Mobility R&D Lab, Eustis Directorate, Ft. Eustis Va 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0002, RESEARCH AND DEVELOPMENT ON CAPACITORS FOR AIRCRAFT HIGH POWER
R. PARKER, Hughes Aircraft Company, *El Segundo, California* 90245 (DF457650; F33615-75-C-2021)

The objective of this program is to develop capacitor technology in two performance regimes. One regime is characterized by small capacitors operating at several hundred pulses per second (hi-rep) and 15 kilovolts. The other regime is characterized by much larger capacitors operating at several tens of pulses per second (lo-rep) and 40 kilovolts. The performance regimes are sufficiently different that it is unlikely the same dielectric system will satisfy both regimes. Although the dielectric systems may be different, design philosophy and techniques, and manufacturing methods are expected to be common to the capacitors of both regimes. Eventual use of both capacitors is likely to be in pulse forming networks (PFN) so that the capacitors may have to operate in a square pulse mode.

The contractor shall provide all materials, services, and equipment for the completion of this program. During the first portion of the program, the contractor will select the dielectric systems and conduct pad tests to establish a firm base for achieving the required capacitor performance. As part of the pad development effort, the contractor will determine the feasibility, desirability, and advantages of winding capacitor pads which contain no kinks or wrinkles. Upon completion of the pad tests, the contractor will design, fabricate, and test both hi- rep and lo-rep capacitors to demonstrate the required performance. An outline of the program tasks is (1) dielectric systems selection, (2) pad design, (3) wrinkle-free capacitor pads, (4) capacitor designs, and (5) capacitor fabrication and test.

ADDENDA: Supporting agency address is: AF Aero-propulsion Laboratory POD, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0003, INVESTIGATION OF HELICOPTER COMPONENT FAILURE PROGNOSIS
J.J. REIS, Northrop Corporation, *Hawthorne, California* 90250 (DA0D3989; DAAJ02-75-C-0019)

The objective of this program is to obtain and analyze data on the relationship of specific sensory outputs to a helicopter gearbox's condition and to investigate their applicability on the determination of the remaining useful life of the component. The efforts to be performed are intended to complement the completed program for investigation of helicopter component failure prognosis under USAAMRDL contract number DAAJ02-72-C-0118.

Conduct mechanical component tests using government-furnished UH-1 series 90 degrees gearboxes in an improved test cell facility capable of providing continuous data collection. Ten gearboxes with incipient bearing failures will be tested over a total test period of 5000 hours. The data shall be processed and analyzed to establish valid predictions of gearbox failure time, time of maximum gearbox deterioration, etc.

ADDENDA: Supporting agency address is: AVSCOM Air Mobility Research and Development Laboratory, Eustis Directorate, Ft. Eustis VA 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0004, RESEARCH IN AERODYNAMICS
I.C. STATLER, U.S. Natl. Aero. & Space Adm., Ames Research Center, *Moffett Field, California* 94035 (DA0C5002)

Conduct basic and applied research in joint participation with the NASA-Ames Research Center to provide a technological base in the aerodynamics of rotary-wing and other V/STOL aircraft. The objective is to expand the technologies in those areas which are most likely to impact improved operational and cost effectiveness, survivability and safety of future Army airmobile systems.

Analytical and experimental studies are selected on the basis of a continual review of the Army's aviation objectives and assessment of those fundamental technological deficiencies which would prevent achievement of the desired objectives. Rotary-wing research will be conducted to develop or improve analytical tools, prediction techniques, and fundamental understanding related to the basic fluid mechanics, acoustics, rotary-wing dynamics and control and flight simulation, and are influenced by the availability of technical personnel and facilities, such as, the 7- by 10-ft low-speed wind tunnel, rotor hover performance acoustic test area, ground-based simulators, computation facilities, and other unique NASA-Ames facilities and support which can be applied to the Army's rotary-wing problems.

ADDENDA: Supporting agency address is: AVSCOM Ames Directorate, Ames Research Center, Moffett Field CA 94035

SUPPORTED BY U.S. Dept. of Defense - Army

1.0005, DEVELOPMENT OF SUPERSONIC STORE SEPARATION METHOD FOR NON-CIRCULAR AIRCRAFT
J.N. NIELSEN, Nielsen Engin. & Research Inc., *Mountain View, California* 94040 (DF137080; F33615-76-C-3077)

Combat effectiveness of military aircraft has decreased over the years. The objective of this effort is to increase combat effectiveness of future systems by developing an analytical tool through which store separation may be factored into the total

system design. Using the tool to be developed under this work effort, self.inflicted damage can be reduced as well as increasing the safe release envelope of future systems. A method to mathematically model the flow field in the region near realistic supersonic aircraft will be developed and used to predict store separation trajectories.

The approach will develop an anlytical method in conjunction with an experimental program. The analytical effort will involve development of mathematical models for the flow fields around realistic fighter- bomber-type aircraft. Next, an experimental program to gather flow field data will be conducted in a tunnel at AEDC. Finally, this data will be used to refine and substantiate the methods developed.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FGC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0006, INTEGRATED-HINGE (ROTARY) ELECTROMECHANCICAL ACTUATION DEVELOPMENT

N.E. WOOD, Garrett Corporation, *Torrance, California* 90509 (DF136740; F33615-76-C-3043)

The needs of survivability and safety of military aircraft cannot be allowed to depend entirely on hydraulically powered control surfaces if any reasonable alternatives can be demonstrated. The cost of providing a hydraulic power distribution system for flight control capability only in future missiles and RPV's may be too expensive. The objective of this program is to design and evaluate the use of integrated-hinge (rotary) electromechanical actuators for low-power (3 HP maximum) control surface actuation. A primary use of these actuators is conceived as actuating small chord trailing edge flaps on larger control surfaces where linear actuators are at a disadvantage in finding space for installation and in providing the conversion to rotary motion in a structurally efficient fashion. The program will provide needed design data concerning the feasibility of electrically powered control surface actuation for military airplanes, missiles and RPV's.

The most promising electromechanical actuator configuration defined under work unit 19870153 will be selected for fabrication. Bench testing of the electromechanical actuation will parallel the type of testing that is now specified for hydraulic actuation of primary control surfaces. Typical frequency response tests will be run with the surface inertia and aerodynamic loads carefully represented. Power-in vs. power- out efficiency, thermal characteristics, and failure modes will be evaluated. Particular attention will be given to establishing a mission duty cycle because all extrapolation for electromechanical actuation use from airplanes to RPV's to missiles is intensely dependent on the duty cycle.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FGL, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0007, RELIABILITY PREDICTION FOR COMBUSTORS AND TURBINES

B. SCHLEIN, United Technologies Corp., *Hartford, Connecticut* 06108 (DF458010; F33615-75-C-2057)

The objective of this program is to formulate a basic analytical and systematic statistical model for use in predicting aircraft turbine engine combustor and turbine life variations (reliability) as a function of mission cycle and uncertainties in the operating environment and design parameters. This basic system will appropriate supporting data, and reliability analysis will be a practical tool for: (1) predicting component field life including mission performance/life trades during the design and development phases of an engine program, and (2) assessing the effect of operating mission variations and design parameter uncertainty on component life during service.

The contractor shall conduct a research program to accomplish the above objectives in the manner set forth in the following paragraphs. Phase I - the contractor shall determine or identify the most probable failure modes in the combustor and high-pressure turbine of current aircraft gas turbine engines. For each failure mode, two failure prediction models shall be developed or provided. The first shall utilize a statistical probability approach using failure-rate data or other appropriate data. The second model shall utilize the physics of failure approach. Throughout the prediction system development, these two models will be compared to each other to establish consistency and uncertainties in the prediction system. Each model shall be formulated such that it will stand alone and can be executed independently. Phase II - the contractor shall modify an available turbine engine mission analysis computer program to simulate the engine environment variations, performance degradation, engine transients and required mission history information for the life prediction models of phase I. Phase III - the contractor shall calibrate the models of phase I and phase II and verify results with appropriate data. An analysis of the uncertainty of the life prediction scheme shall be conducted. Phase IV - the contractor shall assess the component relative life variations for typical current aircraft missions. Three representative alternate missions relative to a base mission shall be analyzed for both a transport and fighter/attack propulsion system. One mission from each application shall be used for study of the uncertainties of model parameters.

ADDENDA: Supporting agency address is: AF Aero-propulsion Laboratory TBC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0008, ADVANCED COMPOSITE DESIGN PROGRAM

R.B. PIPES, Univ. of Delaware, Graduate School, *Newark, Delaware* 19711 (DF138250; F33615-76-C-3126)

Advanced composite structures offer the potential of saving weight and cost on future military airframe structures, and will allow significant increases in aircraft performance (particularly range). The amount of payoff in weight and cost to be realized will depend on the efficiency of the design concepts used. One concept proposed by AFFDL/FB has outstanding promise for a tremendous payoff, but needs development before it can be introduced into production aircraft. This program will develop essential design information on this concept, which features spar caps embedded in composite wing skins.

This effort will investigate promising new concepts for attaching spars to skins in advanced composite wing structures. An existing fighter aircraft will be used as baseline, and the new concepts will be developed to meet the specific requirements of this baseline. Activities to be conducted include preliminary design, detailed design, component fabrication, and testing of the components. A final report will be published.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FBR, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0009, VTOL REMOTELY PILOTED VEHICLES

R.L. SCHAEFFER, U.S. Navy, Aviation & Surface Eff. Dept., *Washington, District of Columbia* 20034 (DN478096)

To develop and demonstrate vertical take-off and/or landing for RPV's by use of a small demonstration vehicle of the tail-sitter type.

Sizing studies and system design will be done, a subsonic wind- tunnel test done to extend existing data to 90-degree angle of attack, and components will be secured and assembled into a small (about 500- pound) flight demonstration vehicle. An experimental flight program from tethered experiments to free flights from shipboard will complete the program.

ADDENDA: Supporting agency address is: Naval Ship R&D Center 01 Bethesda, MD. 20084

SUPPORTED BY U.S. Dept. of Defense - Navy

1.0010, AIRCRAFT/WEAPON PERFORMANCE, STABILITY AND CONTROL

R.E. VANPUTTE, U.S. Air Force, Armament Test Laboratory, *Eglin Air Force Base, Florida* 32542 (DF626580)

To improve present methods and develop new techniques to predict the effects of external store carriage on the performance, stability, and control of aircraft/store combinations.

To review and analyze wind-tunnel and flight-test data, analytical investigations, and empirical research studies in order to identify external weapon parameters which affect carrier aircraft aerodynamic characteristics. Wind-tunnel data will be ob-

tained from AEDC with existing and proposed weapons installed on windntunnel models of the F- 4, A-7, F-15 and other aircraft. Specific stability and control study areas will include: 1. Longitudinal static stability, 2. Lateral- directional stability, 3. Control effectiveness and 4. Effect of weapons on over all aircraft handling qualities. Specific performance study areas will include: 1. Incremental drag coefficient, 2. Range degradation, and 3. Maximum speed degradation.

ADDENDA: Supporting agency address is: AF Armament Laboratory DLJC Eglin AFB, FLA. 32542

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0011, C-130 WELDBOND FUSELAGE PANEL FLIGHT EVALUATION

J.A. KITZER, Lockheed Georgia Company, *Marietta, Georgia* 30060 (DF133360; F33615-75-C-3010)

In-service demonstration and evaluation of structural hardware based on the development and application of new structures and manufacturing technology help provide the necessary confidence required for the adoption of such technology in the design and production of future aerospace systems. The objective of this effort is to conduct an in-service inspection and monitoring program to evaluate the performance of a weldbonded forward fuselage side panel installed on a C-130H aircraft. The weldbonded joining concept promises a 20-30 percent cost savings and increased structural efficiency in the development and production of future aircraft.

Visual, radiographic, and ultrasonic inspections will be conducted periodically to assess the condition of the installed weldbonded fuselage panel and evaluate this construction concept over an extended time period under service conditions. If no problems are encountered, the panel will most likely remain on the aircraft.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FBS, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0012, USAF WAKE VORTEX UPSET LANDING AND TAKEOFF ADVISORY

R.T. MEYER, Lockheed Georgia Company, *Marietta, Georgia* 30060 (DF135970; F33615-76-C-3006)

This program is an analytical effort to define an advisory regarding separation criteria and operational procedures for USAF aircraft during landing and takeoff. The effort addresses recommendations made by an accident review board of a recent accident, that is, (1) a comprehensive study be conducted on the effects of wake turbulence on wing vortices on USAF aircraft where taking off or landing behind other heavier USAF aircraft, and (2) that the results of the above study and information now available in the form of simulation results be used to develop specific separation distances and operational procedure advisories for all types of USAF aircraft when flying in the terminal area.

In terms of this effort, the approach includes: (1) use of analyses and the results from analyses performed in-house at Air Force Flight Dynamics Laboratory concerning landing and the use of a government-furnished digital computer program for analyses of the takeoff, (2) evaluation of data from completed simulation programs and the use of a government-supplied digital computer simulation capability for purpose of defining pilot hazard criteria when encountering wake turbulence in the terminal area, (3) definition of technology and data base deficiencies with identification of a follow-on effort for purposes of filling in technology gaps, and (4) formulation of an advisory on the basis of the above analyses and evaluations which provides aircraft separation distances and possible new operational procedures to be followed for all USAF aircraft when landing or taking off.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FGC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0013, SUPERSONIC JET NOISE II

H. PLUMBLEE, Lockheed Georgia Company, *Marietta, Georgia* 30060 (DF460260; F33615-76-C-2021)

To develop technology to significantly reduce supersonic jet noise with minimum performance and weight penalties. The specific objective is to extend analytical models developed under AF contract F33615-73-C-2032 to more accurately account for the significant noise generation mechanisms in supersonic jets and to verify the models through aeroacoustic experimentation using advanced laser optical techniques.

To refine the jet noise theory and to verify the theory through fundamental acoustic experiments, to provide the necessary turbulence, source function and mean flow models and to verify these analytical models through fundamental aerodynamic experiments, and to develop practical prediction models based on the theoretical and experimental results of the previous phases and on related available research.

ADDENDA: Supporting agency address is: AF Aero-propulsion Laboratory TBC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0014, MOBILE VORTEX DATA ACQUISITION FACILITY

UNKNOWN, I I T Research Institute, *Chicago, Illinois* 60616 (TS58994; TSC-1117)

Trailing vortices from heavy jet aircraft represent a potentially serious hazard to a following aircraft. In order to maintain a high level of safety of operations, large aircraft separations must be maintained, reducing the possible number of runway operations, and hence a Mobile Vortex Data Acquisition Facility (MVDAF) must be delivered. This facility is required by the Wake Vortex Program for the collection of vortex behavior data and the recording of data associated with the evaluation of Wake Vortex Avoidance Systems.

SUPPORTED BY U.S. Dept. of Transportation - Off. Sec.

1.0015, VORTEX DATA ACQUISITION SYSTEM TO BE UTILIZED AT TORONTO INTERNATIONAL AIRPORT

UNKNOWN, I I T Research Institute, *Chicago, Illinois* 60616 (TS59066; TSC-1152)

Trailing vortices behind heavy aircraft represent a potentially serious hazard to a following aircraft both on arrival and departure operations. Therefore, it is the objective to acquire the equipment necessary to collect and record the takeoff vortex data at the Toronto site for subsequent reduction and analysis.

SUPPORTED BY U.S. Dept. of Transportation - Off. Sec.

1.0016, INTERFACIAL ENERGIES OF SOME AEROSPACE METALS AND ALLOYS

T.A. ROTH, Kansas State University, School of Engineering, *Manhattan, Kansas* 66502 (DF041660; AF-AFOSR-2868-75)

AF function - aircraft structures and turbines, exposed to the elements worldwide, suffer general and sometimes catastrophic degradation. Deficiency - it is of particular interest to examine the surface and grain boundary energies of aerospace materials which oxidize or corrode with increasing severity depending upon alloy impurities, ambient gas impurities, and stress state. Objective - this research will determine the surface energy of various aerospace metals and alloys at high temperature and in various atmospheres. How work contributes - many characteristics of metals are influenced directly by interfacial energies, including intergranular corrosion, fatigue strength, creep, frictional resistance, absorption, segregation and adhesion.

The zero creep method and grain boundary grooving method will be used to obtain the surface and grain boundary of titanium, aluminum, beryllium, and alloys.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NE Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0017, VIBRATION CONTROL SYSTEMS FOR AIRCRAFT

D.R. LOGAN, Westinghouse Electric Corp., *Baltimore, Maryland* 21203 (DF135300; F33615-75-C-3119)

Design requirements are needed for controlling the vibratory responses of multi-element functional packages installed in military airplanes. Package performance is sensitive to very small relative motions, both linear and angular, between the package elements. The first objective of this program is to investigate the selective application of vibration control principles to multi-element functional packages and to develop criteria for the selection of the most recent isolators (active and passive) and damping. The second objective is to improve active vibration isolation systems with respect to size, weight, dynamic range, and power requirements. The improved isolators will benefit Air Force weapons systems by increasing system reliability and decreasing system weight and maintenance costs.

The vibration control principles of isolation, detuning, and damping will be studied in their current applications to minimizing linear and angular responses of multi-element functional packages, and criteria for their selection will be developed. Improvements in the size, weight, dynamic range, and power requirements of active isolators will then be investigated. A mathematical model of an improved isolator and package will be developed and performance will be predicted. A breadboard model of the complete package and isolator will be designed and detailed drawings suitable for fabrication will be made.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FBGC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0018, NAVY VEHICLE DESIGN AND CONSTRUCTION - DEVELOPMENT OF A UNIFIED THEORY FOR VORTEX-WING INTERACTIONS

S.E. WIDNALL, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (DN475136; N00014-75-C-0257)

Wing-vortex interactions play a fundamental role in determining the flight characteristics of high-performance aircraft. The objective of this research is to develop a unified theory of vortex-wing interactions for improved understanding and reliable prediction of complex flows over wing surfaces, and for optimizing the application of vortex-wing interactions in the design of high-performance aircraft as well as effecting solutions to their problems.

A more economical version of the Nangia and Hancock three- dimensional wing-vortex interaction model will be developed by the use of continuous loading functions. The primary goal is to develop the capability to predict wing loading or arbitrary planform wings with free vortices. The analysis will include the effects of near-field wing vortex interactions such as vortex breakdown, section peaks, and the rolling up of the leading-edge sheet.

ADDENDA: Supporting agency address is: Office of Naval Research Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

1.0019, NOVEL ARMOR SYSTEMS FOR HELICOPTER SEATS

D.J. PAPETTI, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0F4705)

To investigate novel armor systems using electroslag remelted (ESR) steel as the principal impact surface. The armor protection will be directed to aircrew safety with particular emphasis on armored helicopter seats. Thrust - survivability.

The approach will include investigating various systems, all of which will involve ESR steel as the impact material in a monolithic configuration and as the front face of a composite system. The ESR steel will be hardened to high hardness levels and evaluated at various thicknesses and in composite form with various backface materials including aluminum, woven roving, kevlar, etc. The various systems will be ballistically evaluated against various projectiles including cal .30 ap and cal .50 ap.

ADDENDA: Supporting agency address is: DARCOM Materials & Mechanics Research Center, Watertown MA 02172

SUPPORTED BY U.S. Dept. of Defense - Army

1.0020, HYDROFLUIDIC SERVOACTUATOR DEVELOPMENT, ARMY AIRCRAFT

R.A. EVANS, Honeywell Incorporated, *Minneapolis, Minnesota* 55413 (DA0D3998; DAAJ02-75-C-0035)

To provide the Army with a simple, reliable, inexpensive advanced hydrofluidic servoactuator for hydrofluidic stabilization and control systems.

As a continuation of previous research, an investigation of a fluidic servoactuator servovalve mechanism with an amplifier cascade in place of the flappernozzle will be conducted.

ADDENDA: Supporting agency address is: AVSCOM Air Mobility Research & Development Laboratory, Eustis Directorate, Ft. Eustis, VA 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0021, OPTIMAL CONTROL OF FLEXIBLE AIRCRAFT

F. KONAR, Honeywell Incorporated, *Minneapolis, Minnesota* 55413 (DF133840; F33615-75-C-3046)

The mission payload capability of large transport aircraft such as the C-5A can be adversely affected by the lightly damped dynamic motions of the center of mass and the structure of the aircraft. If this lightly damped motion is not adequately controlled, the fatigue life and ride quality of the aircraft are adversely affected. The objective of this work is to develop an optimal control synthesis technique that will rapidly design a control system for lightly damped motions. This synthesis technique will reduce the engineering man-hours presently required for flight control system design.

The work effort will begin with an in-house survey of the optimal control synthesis methods. Those methods presently available to the AFFDL will be applied to the C-5A ALDCS design problem using the CCVMOD analytical representation of the C-5A. This application will include a study of the various mathematical idealizations of the sensors. Once the most promising optimal control method is identified, a contractual effort will be initiated to study the control synthesis problem in detail and to develop an efficient optimal control program for military aircraft.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FGC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0022, EXPERIMENTAL STUDY OF SIMPLIFIED AIRCRAFT MODELS AND ADVANCED MEASUREMENT TECHNIQUE DEVELOPMENT

B.M. DUFF, Univ. of Mississippi, School of Engineering, *University, Mississippi* 38677 (DF041770; AF-AFOSR-2862-75)

AF function - the study of EMP effects on Air Force systems is very important to the assessment of the survival of these systems in a nuclear environment and to establish hardening procedures. One method of simulating EMP effects is to model aircraft with simple configurations of wires and cylinders. It is important to treat theoretical problems with such configurations as approximations to real systems and also to carry out baseline experiments to check the theory. Deficiency - rigorous analytical solutions for the EMP-induced currents on the conducting surfaces of aircraft are not yet available. This work is to pursue some aspects of this problem. Objective - the previous work on thin wires will be extended for the construction of and the measurement of the current and charge distribution on electrically thick structures. Contribution - measured current and charge distributions covering a range of electrical sizes from thin wires to very thick cylinders will assist in the theoretical development of EMP analysis. This empirical approach will provide a complement to theoretical work in the area. The thrust of this effort will be to extend previous work to electrically thick cylindrical structures containing junctions.

Previous work on moderately thin structures has indicated the need for careful experimentation on thicker structures. The first structure to be studied will be the 90 degree cross consisting of electrically thick cylinders of equal radii. The length of the arms will be chosen to include both resonant and nonresonant conditions. The second structure will be a 90 degree cross consisting of a thick cylinder with a flat rectangular strip as a cross member. The charge and current distributions will be measured on these structures as a function of position on the surface. Since

the transverse dimensions of the structures are electrically large, the current will consist of both axial and transverse components. It is essential that probe transport mechanisms not disturb the electrical continuity of the surface. Particular attention will be given to the experimental test techniques.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NP Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0023, DEVELOPMENT OF A COMPREHENSIVE RDT AND E PROGRAM FOR AIRCRAFT GROUND SUPPORT EQUIPMENT

M. PALAMAR, U.S. Navy, Air Engineering Center, *Lakehurst, New Jersey* 08733 (DN133406)

To develop a systematized RDT&E program which will define and integrate future ground support requirements with a comprehensive RDT&E effort insuring an optimal operational support capability for future- generation aircraft and weapons systems.

Develop a detailed identification of the testing, servicing, maintenance, and handling functions necessary to support aircraft and associated directives, along with organizational structure for the planning and managing of GSE RDT&E. Develop and implement systematic measures to insure prompt consideration of ground support equipment requirements which may be introduced by advancements in airborne systems, changes in support technology, or changes in the operational environment. Develop a long-range plan for GSE RDT&E to parallel aircraft systems and technology forecasts.

ADDENDA: Supporting agency address is: Naval Air Systems Command (Air-340E), Washington, D.C. 20361

SUPPORTED BY U.S. Dept. of Defense - Navy

1.0024, AIRCRAFT RESPONSE TO CONTINUOUS TURBULENCE BASED ON TWO DEGREES OF FREEDOM

J.C. HOUBOLT, Aeronautical Res. Associates, *Princeton, New Jersey* 08540 (DF042040; F44620-76-C-0015)

Air Force vehicles operate under environmental conditions where it is necessary to know the effects of random aerodynamic loads on vehicle performance characteristics. The objective of this effort is to develop simplified reliable methods of estimating longitudinal and lateral response of airplanes to continuous atmospheric turbulence. To accomplish this objective a number of tasks have been outlined. Principal among these are to investiagte simplification of response integrals, develop two D.O.F. models which include gust penetrations, wing-tail interaction and downwash effects, perform vehicle response calculations using this model and to study the accuracies and limitation of this modeling/analysis.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0025, DEVELOPMENT OF LIGHTWEIGHT TRANSFORMERS FOR AIRBORNE HIGH-POWER SUPPLIES

R. MCNALL, Thermal Technology Labs., *Buffalo, New York* (DF455460; F33615-75-C-2014)

This program has as its principal objective, the verification and demonstration of lightweight transformer technology as applied to the increasingly important field of inverter technology. This goal will be reached through the design of a small inverter transformer, its subsequent incorporation in a low-power inverter, making any changes necessary in the design optimization program to account for practical application of the design technique, and finally designing and building two 200 KVA inverter transformers incorporating both SCR switches and a new high-power plasma switch being developed under a separate program.

The contractor will consider as part of his design task all hardware and software necessary for the design and fabrication of a 10 KVA and two 200 KVA transformers and their subsequent incorporation into operating inverters. The design of the transformers shall have as a goal a specific weight of 0.2 pounds per KVA or less and an efficiency in excess of 90 percent. The specific weight shall be computed on the basis of the total weight of core windings, coolant and enclosure.

ADDENDA: Supporting agency address is: AF Aero-propulsion Laboratory POD, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0026, APPROACH/LANDING RADAR DEVELOPMENT

S.T. DRAKE, Riker Maxson Corporation, *New York, New York* 10017 (DF134710; F33615-72-C-1245)

In the event of ILS failure during category III operations, no back-up guidance exists to complete the mission or assess the situation. The objective is to develop hardware which will provide to the pilot a back-up guidance capability which is useful as a monitor during low- visibility operations in the terminal area. The system is to be a self- contained airborne unit, using no ground aids.

This is a contractual effort to develop a high-resolution radar capable of penetrating adverse weather at a distance of approximately 5 miles from the runway. The performance of the system will be determined through a flight-test program using a suitably modified C-141. The ALR picture will be displayed on an electronic attitude director indicator (EADI) and on a head-up display (HUD). The ALR picture will be displayed both by itself and in conjunction with the EADI/HUD symbology.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FGT, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0027, ADVANCED TRANSONIC AIRFOIL INVESTIGATION INCLUDING WALL AND SCALE EFFECTS

J. LEE, Ohio State University, School of Engineering, *Columbus, Ohio* 43212 (DF135630; F33615-76-C-3001)

Current USAF air-superiority fighter designs indicate that an important portion of the aircraft's flight time will be spent maneuvering under high lift conditions in the transonic regime. Analytical research is presently being conducted on advanced transonic airfoils for use on these aircraft. In order to obtain valid empirical data from wind-tunnel tests of these advanced airfoils, flow conditions should approach more closely than in the past those of free flight. Previously, wind tunnels could not achieve free-flight conditions due to the influence of the wall and Reynolds number effects. With the advent of the OSU 6-inch by 22-inch transonic wind tunnel, which has reduced wall effects, it has become possible to simulate a range of Reynolds numbers on the order of those encountered in free flight for acceptable test times. With this facility it becomes possible to separate wall and Reynolds number effects thereby decreasing time to obtain valid data and enabling rapid development of advanced transonic airfoils.

Two advanced transonic airfoil configurations will be tested in the OSU 6x22in. transonic wind tunnel for various test conditions (i.e., several Mach numbers, angles-of-attack and Reynolds numbers). Since wall effects are expected to be small due to the comparatively large distance between the walls and model, it should be possible to quantify Reynolds number effects on the pressure distribution over the airfoil. In addition to the pressure data on the walls and models, fast response probes will define flow detail (e.g., boundary layer).

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FXM, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0028, LOW-COST COMPOSITE RPV WING

C.W. BAKER, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF130380)

The state of the art in advanced composite materials application to aircraft structures has progressed very rapidly in recent years. However, before designers of advanced tactical fighter aircraft will commit themselves to building all-composite major aircraft structural components, the technology must be flight demonstrated on a sub-scale vehicle. The objective of this effort is to flight demonstrate a major aircraft structural component (wing) made entirely of advanced composite material, using an RPV test bed.

An all-composite wing will be designed and fabricated using the latest manufacturing methods. It will undergo static load testing and ground vibration testing, and then be flight tested on a BGM-34C test vehicle. Quantitative measurements of flight loads and structural deflections will be made. The design and fabrication of the wing will be contracted. The integration and flight testing will be performed by AFFDL personnel.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FXSD, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0029, BEARING RESEARCH FOR PROPULSION AND POWER SYSTEMS

R.D. DAYTON, U.S. Air Force, Aero Propulsion Lab., *Dayton, Ohio* 45433 (DF451070)

Develop, utilize and verify a design capability for solving bearing and lubrication problems applicable to current and future aircraft propulsion and power systems. Specifically, raise liquid lubricated rolling element bearing capability to 3 plus million DN and extend bearing fatigue life through the use of better bearing materials. Also, provide solid lubricated bearing designs capable of giving useful lives at speeds up to 60,000 rpm.

Establish and document the results of rolling element bearing computer analyses that incorporate analysis of bearing components, elastohydrodynamic effects, and bearing steel and lubricant properties. Conduct tests on full-scale bearings to provide verification of analyses and to identify where improvements are needed. Conduct tests on new materials to establish fatigue capability. Investigate bearing performance on present and future solid lubricated bearing designs.

ADDENDA: Supporting agency address is: AF Aero-propulsion Laboratory SFL, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0030, SOLID-STATE AIRCRAFT ELECTRIC POWER SIMULATOR EVALUATION

J.M. FARKAS, U.S. Air Force, Aero Propulsion Lab., *Dayton, Ohio* 45433 (DF452210)

This in-house effort covers comparative evaluation of conventional and solid-state A-7 aircraft electrical system simulators to determine advantages, find and correct deficiencies, and thereby guide R&D which will result in application of solid state technology to Air Force aircraft, providing significant improvements in reliability, power quality, and electrical system flexibility, and reduce weight and wiring congestion.

The technical approach of this program includes three phases as follows: Phase I - 1. Preliminary component tests, 2. Install and checkout both simulators, and 3. Steady-state tests of all (512) circuits. Phase II - 1. Switching transient tests, 2. Systems test under each load condition (taxi, takeoff, etc.), 3. MUX system stability, 4. Lighting system (switching, dimming, flashing), 5. Overload and fault protection, and 6. Electromagnetic interference tests. Phase III: 1. System analysis, including power controller load definition and test specifications, 2. Install improved Westinghouse power controllers, and operate simulator for an additional 1000 hours while performing all pertinent power controller/system tests, and 3. Install improved SCI MUX system in the simulator and perform an additional 1000-hour test including detailed analysis of MUX system/electrical power system interface.

ADDENDA: Supporting agency address is: AF Aero-propulsion Laboratory POP, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0031, MILITARY AIRCRAFT DESIGN METHODOLOGY

J.L. FOLCK, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF129020)

In support of the laboratory's aircraft design activities, mathematical and computational methods, incorporating man in the loop where appropriate, are needed for the rapid and accurate definition, analysis, design, and evaluation of flight vehicle systems. Vehicle preliminary design analysis will be achieved primarily by collecting and integrating a variety of methods, programs, and computer graphics hardware into a faster, more accurate, and interactive design synthesis computer program. These techniques will be sufficiently developed to analyze a complete flight vehicle design for a specified mission within a few days, requiring several weeks. The ultimate objective is to make high-speed computing power readily and easily accessible to the designer without requiring him to be familiar with the details of programming and computer hardware.

The approach is to develop and acquire the graphics software and hardware required for a designer to communicate with a large design/analysis program (CASP) via a local graphics console to define the vehicle mission and geometry. Existing, more accurate, aerodynamics and mission analysis modules will be modified for inclusion in the CASP program. Methodology for assessing the impact of emerging technologies will be required and incorporated into the CASP program.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FXBM, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0032, OXYGEN SYSTEM ANALYSIS AND TEST

D.A. GEIGER, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF136600)

Current oxygen systems depend upon ground-based plants which generate liquid oxygen for use in flight. Several new concepts are being explored which could provide on-board generation of oxygen supply, thus eliminating the ground servicing system. The objective of this effort is to evaluate the new concepts relative to LOX in order to select one system which can best meet system requirements relative to life-cycle cost, weight and performance.

Electrochemical, absorbent bed (inorganic and molecular sieve) systems will be compared with liquid oxygen systems for fighters considering factors such as initial and operating cost, weight, diluted and 100 percent oxygen requirements. The uniqueness of the fighter in regard to aircraft dispersion and location of operational bases as opposed to bombers will be particularly scrutinized. Experimental evaluation of breadboard hardware will be conducted wherever the data base needs confirmation. Purity, degradation, and heat dissipation are among factors which will be considered. Results of the analytical and experimental evaluations will be the basis for a plan for the development of a universal on-board generation system.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FEE, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0033, STABILITY AND CONTROL PREDICTION METHODS

D.E. HOAK, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF133300)

The problem involved in accurately defining aerodynamic stability and control characteristics is critical to the successful accomplishment of both strategic and tactical combat missions. This objective is to continually examine new data and theoretical knowledge concerning the understanding and prediction of aerodynamic phenomena, with particular attention given to those aspects pertinent to stability and control. Also, an awareness of existing and potential problems in this area must be fostered to insure appropriate application of existing knowledge and to form a basis for the formulation of programs to overcome critical deficiencies.

Studies of existing and new aerodynamic theory and experimental data compilations will be implemented to establish a comprehensive technology base. Attention will be focused on vital areas in which problems exist or are foreseen and in which technology is deficient. Programs will be planned, and analytical, empirical and graphical relations will be developed to improve the prediction of aerodynamic stability and control characteristics for all classes of flight vehicles.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FBC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0034, INVESTIGATION OF SUPERSONIC WING-TAIL FLUTTER

L.J. HUTTSELL, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF131920)

An important design problem for supersonic fighter aircraft with variable-sweep wings is a flutter instability of the wing-fuselage-tail combination when the wing is close to the horizontal tail where aerodynamic interference is significant. Analytical methods are needed in the design stage to prevent flutter restrictions that degrade the operational effectiveness and affect flight safety. The objective of this effort is to provide experimental flutter data needed to validate new and improved analytical methods required to predict and prevent flutter instabilities. This effort will establish the reliability of the analytical methods used to reduce the costly wind-tunnel and flight flutter tests that are required to assure flight safety of all military aircraft.

A wing-fuselage-tail flutter model representative of a typical fighter aircraft will be tested by the AFFDL/FYS in the AEDC 4T wind tunnel to obtain flutter data in the low supersonic speed regime (m equals 1.3). An in-house effort will be conducted to correlate the test results with analytical results obtained using the recently developed Mach box program (AFFDL-TR-71-108).

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FBRC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0035, NAVIGATION/FLIGHT CONTROL INTERFACE TECHNOLOGY

J.A. KOCHER, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF134830)

With the impending imposition of area navigation upon the civil and military fleet, no definition has been given to the control techniques and accuracy requirements to comply with future national airspace system criteria. The objective is to establish technical requirements for aircraft operations in the area navigation enroute and terminal area flight structures. Information contributing to precise spatial control of Air Force flight vehicles will be generated by this effort.

A study will be made of the navigation requirements from the area navigation enroute flight structure to the terminal area final approach fix. A set of route requirements will be developed to define the various possible maneuvers. The maneuvers will then be studied to determine what restrictions may be required due to the performance characteristics of various aircraft.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FGT, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0036, IMPROVED ANALYSIS METHODS FOR AEROSPACE BATTERY COMPONENTS

D.F. PICKETT, U.S. Air Force, Aero Propulsion Lab., *Dayton, Ohio* 45433 (DF454000)

To establish rapid and reliable instrumental methods for chemical and physical analysis of aircraft, missile and space battery components (electrodes, electrolytes, separators, seals and cell containers).

A. Investigate application of atomic absorption techniques for chemical analysis of electrode materials in various types of batteries. b. Examine feasibility of analyzing electrolyte systems using atomic absorption, infrared spectroscopy, Raman spectroscopy and specific ion electrodes. C. Investigate and develop analytical methods for separator materials. D. Examine and improve existing methods for surface-area measurement of electrodes. E. Evaluate pore volume analysis techniques and establish procedures for applying the most effective ones to analysis of plaques and electrode materials.

ADDENDA: Supporting agency address is: AF Aero-propulsion Laboratory POE, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0037, TEST & EVALUATION OF INFRARED SCANNING SYSTEM FOR THE EMPIRICAL EVALUATION OF HEATING ON TEST MODELS OF ADVANCED MILITARY VEHICLES

E.L. WHITE, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF124540)

Advanced reentry, interceptor, and maneuverable military flight vehicles operate at speeds and in environments which lead to problems with aerodynamic heating. Quantitative data on heating rates in critical areas are desired from uninstrumented wind-tunnel models. A system was developed to remotely measure surface temperature distribution with respect to time on test models. This optical scanning system utilizing a direct digital recording system will measure temperature changes from which surface heating rates can be derived. The objective of this effort is to perform extensive realistic operational tests on this new sophisticated system to prepare it for routine heat-transfer tests in the HTF.

Tests will be performed to further evaluate the performance of the system beyond the scope of the acceptance tests in the contract (ref. work unit 317011-002 agency accession no. DF476582). Tests will be conducted in the AFFDL high-temperature facility with simple flat plate models and finally a model of a recognized military vehicle. Refinements will be made to the system where possible to make testing more routine.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FXNC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0038, MATHEMATICAL MODEL (KRASH) OF CH-47 CRASHWORTHINESS

Y. BADRINATH, Boeing Company, *Philadelphia, Pennsylvania* 19142 (DA0D4040; DAAJ02-76-C-0015)

The objective is to investigate the dynamic structural response of a CH-47A helicopter to crash impact using computer program KRASH and to seek improvements in the KRASH computer program.

The response of a CH-47A to crash impact will be simulated using computer program KRASH. Test data from a full-scale crash test of a CH- 47A at NASA Langley Research Center will be compared to the simulation prediction. Based on this correlation with the CH-47A data, computer program KRASH will be improved. The structural crashworthiness design guide will be updated.

ADDENDA: Supporting agency address is: ABSCOM Air Mobility Research and Development Lab, Eustis Directorate, Ft. Eustis VA 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0039, LOW-COST SURVIVABLE COMPOSITE RPV FUSELAGE SECTION

T.E. HESS, U.S. Navy, Air Development Center, *Warminster, Pennsylvania* 18974 (DN333019)

The in-house design and prototype fabrication of minimum-cost, composite aerial vehicle structures. Principal program emphasis is on minimization of cost, within the constraints of performance, with primary consideration, from design inception, of increased survivability and reduced weight.

Demonstration of program objectives will be attained through in- house analytical design synthesis, fabrication and laboratory proof testing of a fully flight-qualified, minimum-cost/minimum-weight composite material version of the center section of the BQM-34E fuselage. As the program is concerned with structural innovation, the composite component will be aerodynamically identical to the existing structure and compatible with the present propulsion and stability/control systems. It will incorporate integral crack-arrestment features and should have a production cost less than that of the existing metal design. This effort will illustrate cost-effective utilization of new material technology.

ADDENDA: Supporting agency address is: Naval Air Development Center, Warminster, PA. 18974

SUPPORTED BY U.S. Dept. of Defense - Navy

1.0040, RADAR TECHNIQUES FOR AIR FORCE APPLICATIONS IN AVOIDANCE OF BIRD-AIRCRAFT COLLISIONS AND IMPROVEMENT OF FLIGHT SAFETY
S.A. GAUTHREAUX, Clemson University, School of Phy. Math. & Bio. Sc, *Clemson, South Carolina* 29631 (DF031120; AFAFOSR-2782-75)

Af function - bird strikes continue to pose a major hazard to aviation, especially to high-speed low-altitude missions. Radar techniques offer the most definite results of all the current approaches to reduce the bird strike hazard. Deficiency - daytime migration studies have been neglected, which is unfortunate since most daytime migrants move in large tight flocks that pose a threat to aviation. Objective - purposes of these studies are to describe the appearance of daytime migration on radar, determine seasonal and hourly temporal patterns of daytime migration, and investigate the influence of aircraft landing lights on behavior of migratory birds. How work contributes - the results of this research will provide data on daytime movements of birds, thus offering options in mission planning, and should clarify the problem of whether aircraft lights attract or repel birds. This work is identified in RO 1.8.

Radars operated by the FAA and the National Weather Service will be used to detect, describe and quantify the migration of selected species of daytime migrants at three locations in the U.S. In addition, NWS radar films for the last 16 years from 40 locations will be analyzed. Using the FAA radar at Greenville-Spartanburg and Charleston, South Carolina, the effects of landing lights on migrating birds will be observed. This radar is capable of detecting single birds at ranges of 2 to 4 nautical miles.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NL Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0041, ELASTICALLY TAILORED COMPOSITE PROPELLERS
W.J. DWYER, Univ. of Texas, School of Engineering, *Austin, Texas* 78712

DESCRIPTION: The ability to tailor the elastic characteristics of filamentary composite materials is being exploited to improve performance of aircraft propellers and wind turbines. One-piece propellers of the type often used on light aircraft and on small wind turbines operate at maximum efficiency over only a small range of relative wind speed and angular velocity. With the proper selection of elastic properties for the propeller blade, the pitch of the blade can be made to change as the forces on the blade change and as the angular velocity changes. This effect is being used to broaden the range of operating conditions over which high propeller efficiencies can be obtained.

SUPPORTED BY University of Texas

1.0042, ADVANCED INLET/AIRFRAME INTEGRATION CONCEPTS
J.A. CAWTHON, General Dynamics Corporation, *Fort Worth, Texas* 76101 (DF133990; F33615-75-C-3044)

Advanced aerodynamic lift and thrust vectoring systems are being considered which may enable tactical aircraft to reach extreme angles of attack/yaw in the subsonic/transonic flight regime, thus making the requirements for inlet-engine compatibility more severe than in current systems. Design criteria are needed on integration of the inlet system with forward canards to reduce development and acquisition costs for future tactical aircraft. It is the objective of this program to define advanced inlet concepts for this environment which will prevent or attenuate flow distortion at extreme maneuvers, and employ concepts which are low cost, lightweight and with improved reliability.

The approach will be to derive advanced geometry concepts, flow modulation devices and advanced airframe integration techniques. Following a comparative design analysis, preliminary experimental validation will be conducted for proof-of-concept data.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FXMB, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0043, HT 76-8 EFFECTS OF ADVANCED AIRFOILS ON HELICOPTER AGILITY AND LOAD FACTOR
L.F. ELLINGTON, U.S. Army, Air Mobility Res. & Dev. Lab., *Newport News, Virginia* 23604 (DA0D4026)

To develop an analysis for predicting helicopter autorotational capabilities. The analysis technique developed will be utilized to evaluate current and future helicopters in autorotation and to improve piloting techniques during this maneuver.

A survey will be conducted of the techniques commonly used to predict autorotational performance. Performance programs currently available in house, particularly Maneuver Criteria Evaluation Program (MCEP), will be investigated for their adaptability to the problem from the standpoints of accuracy of results and cost to run. An analysis will then be developed by modifying one or more of these in-house programs.

ADDENDA: Supporting agency address is: AVSCOM Air Mobility R&D Lab, Eustis Directorate, Ft. Eustis VA 23604

SUPPORTED BY U.S. Dept. of Defense - Army

1.0044, CENTRAL FLOW CONTROL (CFC) SPECIFICATIONS FOR AIR TRAFFIC CONTROL SYSTEMS COMMAND CENTER
UNKNOWN, Braddock Dunn & Mcdonald Corp., *Vienna, Virginia* 22180 (FA59095; FA76WA-3792)

OBJECTIVES: (1) Conduct an in-depth analysis of the 9020 Monitor; To identify those functional capabilities which will have to be developed in order to support the CFC data base requirements. (2) Conduct an in-depth analysis of the CFC operational requirements (Operational Requirements for the Air Traffic Control Systems Command Center (ATCSCC) 9020 Computer Program); to determine the specific data base structure that is best suited to meet these requirements. (3) Develop and submit a Computer Program Functional Specification (CPFS) for both the monitor enhancements and the data base subsystem.

SUPPORTED BY U.S. Dept. of Transportation - Off. Sec.

1.0045, SOLID PATH HUD OPTICS SYSTEM
F. BREM, Sundstrand Data Control Inc., *Redmond, Washington* 98052 (DF136200; F33615-76-C-0023)

The requirement exists in current Air Force fighter aircraft for wide-field-of-view head-up display systems. Because of the long optical path necessitated by fighter aircraft design, a wide-field-of-view HUD often requires large pilot head movement. It is the objective of this effort to provide a solid acrylic plastic HUD optical system for AFFDL investigation as a possible solution to this problem.

A contractor-designed solid acrylic plastic HUD optics system will be built and evaluated in an AFFDL simulator to determine its applicability to the fighter aircraft HUD field-of-view problem. If the equipment proves acceptable, it will be installed in a fighter aircraft for flight testing. Following a successful flight-test effort, recommendations will be made to ASD to include the equipment design in future fighter aircraft procurements.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FGR, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

ASTRONAUTICS

Includes Astronautics (general); Astrodynamics; Ground Support Systems and Facilities (space); Launch Vehicles and Space Vehicles; Space Transportation; Spacecraft Communications; Command and Tracking; Spacecraft Design, Testing, and Performance; Spacecraft Instrumentation; and Spacecraft Propulsion and Power. For Related Information See Also Aeronautics.

2.0001, HEAVY PAYLOAD PROGRAM
E.T. BYRAM, U.S. Navy, Res. Laboratory, *Washington, District of Columbia* 20375 (DN480104)

Develop and fly heavy space instrumentation matched to the capability of large, low-cost carrier rockets (ARIES) and of large satellites (HEAO and the shuttle).

In the X-ray, Y-ray region evaluation of emission from the natural background and from man-made objects profits from the increased sensitivity provided by large detectors. Pointed payloads and large sensors are developed and used: (1) to define the limits placed by nature on space military systems, (2) to augment technology for inspection of man-made objects in space, and (3) to study physical processes and systems not possible to study from the ground.

ADDENDA: Supporting agency address is: Naval Research Laboratory (7000), Washington, D.C. 20375

SUPPORTED BY U.S. Dept. of Defense - Navy

2.0002, SPACE POINTING AND TRACKING
G. OUELLUETTE, Charles Stark Draper Lab. Inc., *Cambridge, Massachusetts* 02139 (DF742590; F30602-76-C-0032)

The objective of this effort is to assess the limitations imposed on large-aperture, ultra-precision pointing and tracking systems due to current state-of-the-art technology capabilities, or reasonable extensions of these capabilities. This evaluation shall include impact assessments of orbital and navigational data qualities on the capabilities of such space systems.

Current state-of-the-art spacecraft technology will be reviewed and analyzed in regard to pointing and tracking capabilities and positional data accuracy impact on these capabilities.

ADDENDA: Supporting agency address is: Rome Air Development Center OCT, Griffiss AFB, NY.13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

CHEMISTRY AND MATERIALS

Includes Chemistry and Materials (general); Composite Materials; Inorganic and Physical Chemistry; Metallic Materials; Nonmetallic Materials; and Propellants and Fuels.

3.0001, MATERIALS SUPPORT TECHNOLOGY - POLYMERIC MATERIALS WITH SPATIAL GRADIENTS IN STRUCTURE AND PROPERTIES
M.C. SHEN, Univ. of California, School of Engineering, *Berkeley, California* 94720 (DN223290; N00014-75-C-0955)

The use of polymeric materials by the Navy is pervasive, varying widely in form and function from rubber tires to hydraulic fluids. The properties of such materials are sensitive to the chemical nature and physical arrangement of constitutent long-chain molecules. This research provides a means for introducing controlled structural variations to improve the performance of plastics and rubber materials in military applications such as noncrazing aircraft windows, noise, shock and vibration absorbers and plastic gasoline tanks.

Chemical and physical methods for generating ordered, spatial variations in the composition, structure and properties of polymers are investigated. These studies will cover alternative perparative and characterization techniques as well as mechanical and transport properties. Emphasis will be placed on determining relative merit and limits of promising approaches and the development of property-structure relationships in metal systems.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

3.0002, FAILURE MECHANISMS IN NICKEL-HYDROGEN CELLS
E. LEVY, Hughes Aircraft Company, *El Segundo, California* 90245 (DF457670; F33615-75-C-2025)

To increase the performance, life and reliability of nickel-hydrogen energy-storage cells by identifying and countering critical causes of degradation and failure.

This program provides for exploratory development on techniques for countering known and suspected failure mechanisms in nickel-hydrogen cells. It emphasizes problems related to electrolyte management, thermal management and oxygen management. Work will be conducted primarily on cells and cell-related structures, components and materials. For those failure mechanisms for which effective solutions are found and demonstrated in component-level laboratory tests, final verification of the effectiveness of the solution will be made in full-size lightweight cells. General solutions which will be effective in all orbits are desired, but verification of the solutions will be done under the simulated orbital conditions which are most rigorous for the solution-- usually low orbit.

ADDENDA: Supporting agency address is: AF Aero-propulsion Laboratory POE, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0003, INVESTIGATION OF GAS-PHASE REACTIONS OF IMPORTANCE IN IGNITION PROCESSES 14175-CX
S.W. BENSON, Univ. of Southern California, Graduate School, *Los Angeles, California* 90007 (DA0E9112; DAAG29 76 G0195)

AF function - (1) to measure rates and determine mechanisms for a number of gas phase reactions of importance in hydrocarbon-oxygen ignition processes, (2) to evaluate known flame and ignition inhibitors for their probable chemical roles in influencing important ignition steps, and (3) to evaluate the role of the above reactions in ignition and inhibition processes in light of the rates obtained. Relevance - the Army uses large quantities of flammable liquids in its ground combat vehicles and aircraft. Fuels, in particular, increase the vulnerability of vehicles to munitions attack and make storage areas quite hazardous during combat. To understand and thereby control fire and explosion hazards of fuel storage areas and to develop the needed 'fire-safe fuels', knowledge of the basic chemistry of ignition and inhibition is essential.

Rates will be determined using three distinct experimental approaches: (a) very low pressure pyrolysis (VLPP) methods will be used to study a number of key reactions involving alkyl radicals, alkylperoxy radicals, and oxygen. (b) Higher pressure static or flow methods will be used to investigate reactions of alkyl hydroperoxides with peroxy radicals, with or without added inhibitors. (c) A method using a laser pulse to rapidly heat and thereby induce reaction in an appropriate gas mixture will be used to study hydrocarbon radical-oxygen-inhibitor reactions free of unwanted wall and induction-period effects.

ADDENDA: Supporting agency address is: DARCOM Army Research Office Box 12211, Research Triangle Park NC 27709

SUPPORTED BY U.S. Dept. of Defense - Army

3.0004, UNIFIED IGNITION MODEL
H. BRADLEY, U.S. Navy, Michaelson Laboratories, *Ridgecrest, California* 93555 (DA0L4493)

To develop a unified ignition model for propellants.

The interim mathematical formulation will include the addition to conduction, surface regression, subsurface reactions, and in-depth absorption of radiation. The surface reaction layer formulation will include surface decomposition expressed in terms of three chemical processes, successive surface decomposition events (i.e., gasification prior to flame development, formation of decomposition products on the surface, pyrolysis after flame formation), and heating by conduction from the adjacent gas phase, and by radiation and convection from external sources. The gas-phase and flame-zone formulation will account for two reaction pathways, conduction normal to the surface, convection normal to the surface, and diffusion between reactants and products. After success has been achieved with this formulation, additional features which account for more details of chemical processes will be incorporated into the model.

ADDENDA: Supporting agency address is: DARCOM Ballistic Research Labs, Aberdeen PG MD 21005

SUPPORTED BY U.S. Dept. of Defense - Army

3.0005, NAVY VEHICLE DESIGN AND CONSTRUCTION - LASER WELDING OF METALS AND ALLOYS
E.M. BREINAN, United Technologies Corp., *Hartford, Connecticut* 06108 (DN475434; N00014-74-C-0423)

The development of new welding processes is important to the effective use of higher strength metal alloys in naval components. Laser welding is a process of great potential whose characteristics have not been examined in detail. The investigator will determine the influence of many parameters of laser welding on a wide range of metal alloys.

High-strength structural steel (130,000 psi yield) and 5456 aluminum alloy will be laser welded and extensive mechanical testing performed on the welded specimen. Effects of the laser operating mode, optical parameters, power density, and shielding gas will be determined with respect to welding performance using a carbon-dioxide laser. Plasma formation above the weld will be examined with the aim of eliminating its detrimental effects on depth of penetration.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

3.0006, FLAMEHOLDER COMBUSTION INSTABILITY STUDY

R. ERNST, United Technologies Corp., *West Palm Beach, Florida* (DF459250; F33615-76-C-2023)

To conduct a combined analytical and experimental research effort to determine or recommend improved flameholder designs to control or eliminate conditions which lead to low-frequency augmentor instability.

This is the second of a series of 3 procurement actions that will result from this program. Program II will be an in-depth investigation of the heat release at the flameholder subject to longitudinal pressure disturbances; program III will be the theoretical treatment of the acoustic nature of a turbofan augmentor during a low-frequency instability.

ADDENDA: Supporting agency address is: AF Aero-propulsion Laboratory TBC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0007, STUDY OF INTERMETALLIC COMPOUNDS

J. MILLER, United Technologies Corp., *West Palm Beach, Florida* (DF680850; F33615-75-C-1166)

The objective of this program is to determine the suitability and potential of titanium aluminum (TiAl) base materials for use in aircraft turbine engines. It is of specific importance to study the response of this material, as an example of a class of materials, to the stresses, strains, and environment found in a gas turbine engine.

The program shall consist of the selection, preparation, processing, and characterization of a suitable composition based on the intermetallic compound TiAl. At the same time the manufacturing process steps necessary to produce turbine blades shall be explored and assessed. If it is determined that the necessary techniques are available, a partial set of turbine blades may be fabricated using an existing design. These blades shall be bench- and rig-tested and, if suitable, may be made available for later engine testing.

ADDENDA: Supporting agency address is: AF Materials Laboratory LLM, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0008, DEVELOPMENT OF HOLOGRAPHIC RECORDING MATERIALS

A.A. FRIESEM, Weizmann Institute of Science, *Rehovot, Israel* (DF138660; AF-AFOSR-3004-76)

Photoplastics and photodielectric polymers exhibit a high potential as efficient, low-cost recording materials for holography. Development work is required, however, before these materials can be utilized. In this effort, recording materials needed to facilitate making real-time holograms will be developed. This will provide improved techniques for performing nondestructive inspection of aircraft to determine structural integrity.

Photoplastics and photodielectric polymers will be used and evaluated in holographic tests representing typical real-time recording arrangements.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FBE, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0009, CHEMICAL KINETICS

G.E. KELLER, U.S. Army, Ballistic Research Labs., *Aberdeen Proving Ground, Maryland* 21005 (DA0M4529)

The objective of this research is an understanding of the gas-phase chemical kinetics of the combustion of propellants in sufficient detail to permit predictions of material optimization.

Gas-phase reaction-rate coefficient measurements and multiple- species chemical models will be used in this study. As the measurements furnish the details for the computer model, the modeling effort identifies those key steps and mechanisms that are most important for detailed studies.

ADDENDA: Supporting agency address is: DARCOM Ballistic Research Labs, Aberdeen PG MD 21005

SUPPORTED BY U.S. Dept. of Defense - Army

3.0010, RADICAL MECHANISMS IN IGNITION OF PROPELLANTS

C.U. MORGAN, U.S. Army, Ballistic Research Labs., *Aberdeen Proving Ground, Maryland* 21005 (DA0F4424)

One of the theories related to ignition of propellants stresses the importance of solid-phase reactions as the most important energy-release mechanism in the ignition phenomenon. The objective of this task is to construct a system which will allow the study of initiation of propellants by thermal pulses. Radicals produced by these mechanisms will be detected and analyzed by electron spin resonance (ESR). It is hoped that within the first year some work will have been completed on the initiation of ammonium perchlorate, potassium nitrate and some nitro compounds such as dinitrotoluene, picric acid and nitromethane. The work will be performed at BRL.

To shed some light on the chemical mechanisms in combustion we propose to explore the ignition mechanism by use of spin resonance (ESR) techniques. The production and observation of free radicals by thermal techniques is not a simple matter. Radicals have been produced readily by higH-energy radiation. Here heating effects are negligible and the crystalline lattice of the compound can act as a trap for the radicals. However, in the heating process of pyrolysis these crystalline fields are broken and the radical is free to migrate and react. Thus we propose to irradiate single crystals held at low temperature with various heating sources in the hope of initiating reaction without a complete breakdown of the crystalline fields. We will also employ other techniques such as photosensitization of the compound. The crystal will be doped with compounds that will enhance the energy transfer mechanism from optical radiation to thermal effects. The chief advantage in using ESR is that the reaction need only proceed a very small amount (0.0001 percent) in order to produce enough radicals for observation. The ESR technique also allows observation of the reaction in the solid state.

ADDENDA: Supporting agency address is: DARCOM Ballistic Research Labs, Aberdeen PG MD 21005

SUPPORTED BY U.S. Dept. of Defense - Army

3.0011, DETERMINE FABRIC DATA REQUIRED FOR TENTAGE DESIGN PROGRAMS

C.J. MONEGO, U.S. Army, Natick Research & Dev. Command, *Natick, Massachusetts* 01760 (DA0G4247)

To develop a strength-vs.-weight coefficient for specific fabric construction and fiber types which are to be used in design manuals for tentage. This strength-vs.-weight coefficient can also be used for any end item in which the forces and fabric loads can be determined, such as parachutes, conveyor belts, and life-saving structures such as pressure suits, rubber boats, evacuation shutes for aircraft and other end items.

The approach to this problem is to obtain selected commercial fabrics, limited in this study to nylon and polyester fibers, test and analyze the fabrics obtained to establish a weight-vs.-strength coefficient for each fiber type. The selection of nylon and polyester fibers is based on the usage of these fibers in military industrial type fabrics in tents, air-supported structures and other end items. The commercial fabrics will be tested for strength under both biaxial and shear stress conditions and the fabric construction variables such as weave, fiber type, yarn count, yarn crimp and ends and picks per inch will be determined relative to their effect on weight-vs.-strength coefficient for each fiber type.

ADDENDA: Supporting agency address is: NARADCOM Natic Development Center, Natick MA 01760

SUPPORTED BY U.S. Dept. of Defense - Army

3.0012, FRACTURE MECHANICS STUDIES IN DESIGN
O.L. BOWIE, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0F4743)

This work addresses program thrust G-2, 'survivability of aircraft and combat vehicles', and aircraft pacing problem 26, 'improved methods of linear and nonlinear stress analysis'. Methods will be developed and applied for the stress analysis of design configurations with particular emphasis on 3-d solutions. Applications to fracture criterion, crack growth, etc., will be considered in accordance with the concepts of fracture mechanics.

The previous experience of methods developed at AMMRC will be utilized along with existing finite-element codes. The further development of the combined technique (hybrid method) consisting of finite elements and the modified mapping collocation technique is planned. The joining of these techniques is currently being considered in the solution of several model problems. Extension of these techniques into the 3-d regime will be investigated. The application of this extension to model problems will provide a method of analysis for hitherto intractable design problems.

ADDENDA: Supporting agency address is: Darcom Materials & Mechanics Research Center, Watertown MA 02172

SUPPORTED BY U.S. Dept. of Defense - Army

3.0013, GLASS-CERAMIC ARMOR MATERIAL DEVELOPMENT
G.M. HARRIS, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0F4791)

The major objective of this project is to develop new glass-ceramic formulations and processing procedures for their manufacture. Ballistic protection requirements are for the defeat of caliber .30 ap projectiles. The material developed will be of lower cost than present state-of-the-art ceramic armor materials. In addition, complex shapes will be more easily formed. These will provide protection for helicopter components at a reasonable cost. A minor effort will be directed towards the development of ceramic-plastic composites for the defeat of laser weapons. Thrust - cost reduction.

The glass-ceramic material and process development project will be directed toward the fabrication of high-hardness glass-ceramic by altering the composition of commercially available glass-ceramic materials to increase the hardness. The effect of variables on microstructure, properties and ballistic protection will be investigated. Material characterization will be performed (80 percent of program effort). The ceramic component for defeat of laser threats will be fabricated by the thixotropic casting process and impregnated with a plastic. Extensive material characterization will only be performed on materials which appear promising in laser testing (20 percent of program effort).

ADDENDA: Supporting agency address is: DARCOM Materials & Mechanics Research Ctr., AMXMR-EO, Watertown MA 02172

SUPPORTED BY U.S. Dept. of Defense - Army

3.0014, EVALUATION OF Al-GRAPHITE COMPOSITE WITH RESPECT TO SURVIVABILITY
A.A. IANNELLI, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0F4744)

The technical objective is to obtain basic data on ability of Al- graphite composite panels to withstand ballistic damage and yet maintain structural stability. This work is essential to meet military requirements of high-strength, high-modulus, low-density structural members with ballistic damage capability in Army aircraft.

Tests on hot-pressed Al-graphite samples will be conducted to determine basic structural capability data after ballistic damage. Resistance to penetration and buckling resistance will be determined. Fiber-matrix interaction will be examined microscopically after testing to obtain feedback data for changes in processing techniques.

ADDENDA: Supporting agency address is: DARCOM Materials & Mechanics Research Center, Watertown MA 02172

SUPPORTED BY U.S. Dept. of Defense - Army

3.0015, MASS-SPECTROMETRIC STUDIES OF HIGH-TEMPERATURE MATERIALS
A. KANT, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0D4818)

The objectives are: (1) To measure the high-temperature thermodynamic properties (energetics of formation of solid solutions and compounds, phase equilibrium) of low-density, high-strength materials which have potential use as structural materials (aircraft) and projectile-resistant materials (armor). The systems to be investigated include carbides, nitrides, silicides, and borides with the present specific emphasis on the aluminum-boron system; (2) to determine the kinetics and establish the mechanism of vaporization processes involving these materials. The work is relevant in all areas where a knowledge of the stability (both thermodynamic and kinetic) of high-strength, low- density materials are required for design and fabrication purposes. Specific examples of applicability are: high-temperature-resistant materials for rotor blades and vanes, and materials exposed to rocket exhaust and turbine inlet high temperatures.

Molecular beams formed from the evaporated molecules are studied by mass spectrometric techniques to elicit information about the nature and properties of the molecules in the beam and of the condensed phases in equilibrium with the vapor. Kinetics of vaporization are studied by measuring the rates of formation of various vapor species under conditions in which the vaporization process is the rate-determining step in production of the molecular beam.

ADDENDA: Supporting agency address is: DARCOM Materials & Mechanics Research Center, Watertown MA 02172

SUPPORTED BY U.S. Dept. of Defense - Army

3.0016, HARD-FACING COATING MATERIALS FOR FRICTION AND WEAR APPLICATIONS
C. LEVY, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0E4818)

To improve the wear resistance of tool steels and other conventional steels by applying thin hard-facing coatings.

Materials such as steels, titanium alloys and aluminum alloys require improved anti-friction and wear properties as they are subjected to higher pressure and higher temperature applications. In particular, machine tools are subject to these phenomena and need frequent replacement. Methods of application of hard-facing coatings were to include cathode sputtering, ion plating, vapor deposition and plasma spraying. Coating materials may include titanium diboride, titanium carbide, tungsten carbide and other materials. Evaluation of the coatings will be performed by examination of hardness, adhesion, and wear testing.

ADDENDA: Supporting agency address is: DARCOM Materials & Mechanics Research Center, Watertown MA 02172

SUPPORTED BY U.S. Dept. of Defense - Army

3.0017, STRESS CORROSION AND HYDROGEN EMBRITTLEMENT OF ESR AND MARAGING STEELS FOR MISSILES
A.K. WONG, U.S. Army, Materials & Mechanics Res. Ct., *Watertown, Massachusetts* 02172 (DA0E4750)

Determine and evaluate factors affecting the stress corrosion characteristics and mechanical properties of ultrahigh-strength alloys such as ESR and maraging steels for missile aircraft and armor applications. In addition, the potential deleterious effects of conventional surface treatments and hydrogen embrittlement will be investigated. Maraging steels are currently used in components such as rocket motor cases, drive shafts, landing gear parts, pins, and hinges. ESR steels have demonstrated potential as vehicular armor. Thrust area is air defense.

Solution treated 250 and 350 grade maraging steel sheets of higher purity will be subjected to selected thermomechanical treatments approximating conditions encountered during fabrication of missile components. Mechanical properties and stress cor-

rosion cracking characteristics (e.g., K SCC) will be determined. Also, the stress corrosion characteristics of armor-grade ESR steels will be determined. Either distilled water or aqueous NaCl environments will be employed. Further, the effects of various conventional metal surface treatments on the properties of both ESR and maraging steels will be assessed along with experimental studies of related hydrogen embrittlement phenomena. Modes of SCC failure will be determined by examination of fracture surfaces utilizing replica electron microscopy techniques.

ADDENDA: Supporting agency address is: DARCOM Materials & Mechanics Research Center, Watertown MA 02172

SUPPORTED BY U.S. Dept. of Defense - Army

3.0018, CATALYTIC COMBUSTION FUEL/AIR CARBURETOR

G. ROFFE, General Applied Sc. Labs. Inc., *Westbury, New York* 11590 (DF459550; F33615-76-C-2070)

To obtain a fuel/air carburetion system for use as part of the in- house evaluation of catalytic combustion.

A contractural effort to design, fabricate and characterize carburetors was initiated. Specified performance (degree of fuel vaporization, composition and velocity uniformity) and avoidance of ignition within carburetor must be demonstrated.

ADDENDA: Supporting agency address is: AF Aero-propulsion Laboratory SFF, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0019, EFFECTS OF OXYGEN AND WATER VAPOR ON THE COMPRESSIVE STRENGTH OF BOUNDARY FILMS ON IRON CRYSTALS

D. SNEDIKER, Battelle Memorial Institute, *Columbus, Ohio* 43201 (DF044220; AF-AFOSR-3051-76)

AF function - propulsion systems for advanced aerospace vehicles require improved lubricants which will withstand a wider range of temperature conditions, greater contact loads and higher shear rates. Deficiency - available lubricants continue to fail due to the detrimental effects of water vapor and oxidation. Objective - investigate the effects of atmospheric oxygen and water on boundary film formation. How work contributes - the information gained from this research will be used to formulate improved lubricants for critical AF applications.

Chemical kinetic methodology will be applied to the study of the film-forming process and the behavior of the films will be determined, as manifested by the compressive strengths, with respect to time temperature, oxygen and water vapor. Model systems clearly relatable to real lubricants and steels will be used in this study.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NC Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0020, RECLAMATION OF SYNTHETIC TURBINE ENGINE OIL MIXTURES

G.A. BEANE, Monsanto Research Corporation, *Dayton, Ohio* 45407 (DF458700; F33615-76-C-2037)

Develop an effective method for reclaiming overaged and used synthetic turbine engine oil mixtures.

Survey industrial reclamation techniques. Identify and resolve problem areas and technical deficiencies. Develop a reclamation technique. Feasibility of the technique will be demonstrated by restoring at least one batch of used Mil-l-7808 engine oils to satisfactory performance criteria.

ADDENDA: Supporting agency address is: AF Aero-propulsion Laboratory SFL, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0021, DEVELOPMENT AND EVALUATION OF KEVLAR-29 MATERIAL FOR WEAPON SYSTEM PARACHUTE RECOVERY APPLICATION

C.A. BABISH, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF131600)

The weight of current parachute recovery subsystems for military vehicles, crew escape modules and weapon systems, which represents approximately 6 percent of total system weights, contributes to development, production and maintenance costs of the systems. The objective of this program is to develop and evaluate a new parachute material that offers the potential for a 50 percent reduction in recovery subsystem weight and hence could effect significant savings in the cost of total systems.

Parachute materials such as threads, cords, cloths, tapes, ribbons and webbings will be woven using high-strength, high-modulus Kevlar-29 yarns of various twists and deniers to achieve the required material strength and energy absorption characteristics. Material and seam and joint properties will be established using standard test methods. The applicability of the new materials to parachute recovery subsystems will be determined through comparative evaluations of the results obtained from fully instrumented wind-tunnel, sled and aerial tests of model and full-scale Kevlar-29 and nylon parachutes.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FER, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0022, EVALUATION AND OPTIMIZATION OF COMBAT AIRCRAFT MATERIALS AND COMPONENTS FOR SURVIVABILITY ENHANCEMENT

C.W. HARRIS, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF132560)

Degradation of materials, such as internal and external fuel tank foam, due to environmental effects can reduce their effectiveness in enhancing the survivability of combat aircraft against various nonnuclear threats. The objective of this effort to optimize combat aircraft components and materials to minimize vulnerability to nonnuclear threats. Such optimization of aircraft materials is expected to result in great cost savings to the services through longer life and an increase in aircraft/pilot survivability to nonnuclear threats.

This effort will include: (1) studies to determine what effects the environment has on the basic chemical structure of materials, such as the fuel tank foams, through chemical and physical tests and analysis of the affected materials, (2) determination of what modification (chemical and/or physical) must be made in the presently used material to improve them and make them more reliable, (3) attempts to make such modification in the material, (4) determination of how the modified material responds to realistic environments to be seen by aircraft, (5) evaluatation of survivability/vulnerability effectiveness of modified (or new) materials by means of a nonnuclear threat test evaluation of mockups similar to the designs encountered on current Air Force aircraft (e.g., A-7, F-4, AH-1G, F-15, B-1, A-10). Coordinate with materials laboratories of other services for assistance in improving present materials or findings/developing new materials.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FES, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0023, TOXICOLOGY OF JET FUELS, LUBRICANTS AND ADDITIVES

H. LANDER, U.S. Air Force, Aero Propulsion Lab., *Dayton, Ohio* 45433 (DF456610)

To provide adequate toxicological information for the safe handling, transportation, R&D testing, and operational use of POL materials.

Additives to jet fuels and lubricants lack toxicology information. The data obtained will include range-finding skin and oral toxicity data. Initial toxicological data on high-density fuel will include inhalation lethal concentration -50 data. Subacute 6-week inhalation tolerance limits will be required.

ADDENDA: Supporting agency address is: AF Aero-propulsion Laboratory SFL, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0024, STIMULATED ANTI-STOKES RADIATION IN GASES
P.W. SCHREIBER, U.S. Air Force, Aero Propulsion Lab., *Dayton, Ohio* 45433 (DF458810)

AF function - laser development, combustion studies, compressor studies, chemical emissions, aerodynamic testing. Deficiency - on-site methods are needed to determine temporarily and spatially resolved species concentrations in reacting and nonreacting flows. Research - development of an experimental theoretical base for the applications of stimulated anti-Stokes spectroscopy to the measurement of species concentrations in plasma and gases. How research contributes - a recent experimental test at Onera, France, showed that stimulated anti-Stokes radiation can be used to measure the density of molecular hydrogen in reacting flows. The intensity of this radiation produced is measured by ordinary Raman scattering. This new approach will be investigated and extended to include other molecules of interest to the Air Force.

The measurements at Onera were restricted to H sub 2 because the high-intensity Stokes radiation was generated in high-pressure hydrogen cells. To extend the method to other species, high-power, tunable lasers will be used to generate the Stokes beam at the required frequency for given molecular species. Several systems will be designed based on available pump and tunable lasers. An assessment will be made of the applicability of these systems to current Air Force research and development programs. Coordination of this program has been made with other AFSC laboratories. It is anticipated that a joint effort will be made with AFAPL.

ADDENDA: Supporting agency address is: AF Aero-propulsion Laboratory POP, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0025, EFFECTS OF TURBULENCE ON GLOW DISCHARGE
F.D. STULL, U.S. Air Force, Aero Propulsion Lab., *Dayton, Ohio* 45433 (DF456790)

To investigate the effects of turbulence on glow-to-arc transition in a flowing gas with emphasis on increasing power deposition to the gas in the glow discharge region at high pressure (100 - 250 torr).

Several turbulence generators of various types will be introduced into flowing nitrogen and a glow discharge initiated. The discharge and flow are to be aligned. The voltage-current of characteristics, and hence power, will be recorded. Interest will of course be in those turbulence generators that result in increases in power deposition beyond that attainable without turbulence generators. Those so identified will be inserted into a flow consisting of CO2 and N2 in order to determine if the results in N2 alone are valid in a laser gas mixture.

ADDENDA: Supporting agency address is: AF Aero-propulsion Laboratory TFE, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0026, SONIC FATIGUE TESTS OF ADVANCED MATERIALS AND STRUCTURAL CONFIGURATIONS FOR APPLICATION ON MILITARY AIRCRAFT
H.F. WOLFE, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF138170)

Advanced structural materials, hybrids of both composite and conventional materials, and advanced fabrication techniques for high- temperature honeycomb panels have been developed for application on military aircraft. The objective of this program is to evaluate the sonic fatigue resistance of: (1) a B-1 composite stabilizer, (2) cross- plied borsic/titanium panels at room and elevated temperatures, (3) two candidate configurations of high-temperature stainless steel honeycomb panels and (4) selected Air Force operational aircraft by investigating service failure data.

Sonic fatigue tests will be conducted on each test structure in the AFFDL sonic fatigue facility by subjecting each structure to a prescribed high-intensity acoustic environment. Some structures will be simultaneously subjected to high-intensity noise and elevated temperatures. Aircraft service failure data will be obtained from available computerized AFLC maintenance records.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FBFA, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0027, LITHIUM-INORGANIC ELECTROLYTE BATTERY INVESTIGATION
D. CHUA, Honeywell Incorporated, *Montgomeryville, Pennsylvania* 18936 (DF457310; F33615-74-C-2071)

The objective of this effort is to determine the performance capability of lithium inorganic oxychloride battery system toward certain goals.

This is a 19-month effort consisting of three tasks directed at each of the three classes of applications. Task 1 - life support, task 2 - spacecraft 'A', and task 3 - spacecraft 'B'.

ADDENDA: Supporting agency address is: AF Aero-propulsion Laboratory POE, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0028, RESEARCH ON PHASE TRANSFORMATIONS AND NON-EQUILIBRIUM INTERFACES IN ALLOYS
J.S. LANGER, Carnegie Mellon University, Mellon Institute of Science, *Pittsburgh, Pennsylvania* 15213 (DF043970; F44620-76-C-0103)

AF function - this proposed research primarily falls in the 2.1 research objectives which deal with new materials research. The goals are to form a rational basis for creating or improving material systems such as alloys, polymers, ceramics, and composites. This can be attained through understanding of the principles that govern the properties and gross behavior as functions of microstructural features. Deficiency - the understanding of phase transformations is of vital importance to the development of desirable material properties by the metallurgists. This is especially true for aircraft applications where high performances-to- weight ratios are vital, as, for example, in the lightweight titanium- based alloys. Objective - the objective of this proposal is to perform investigations of non-equilibrium interfaces; in particular, study the instabilities, cellular structures, and the onset of dendritic growth, study the departures from local equilibrium and the theory of interface control, apply the theory of spinodal decomposition developed by one of the investigators to realistic systems and make models of isothermal solidification in the liquid-layer joining process. Contribution - this research is a part of a new comprehensive program in statistical mechanics.

This proposal is to investigate the general area of non-equilibrium interfaces. In contrast to a detailed study of interfacial kinetics, this project looks at the interfacial stability and the formation of cellular or dendritic structures during phase transformations. These basic concepts are relevant to a broad range of solid-liquid and solid- solid phase transformations. The anaylsis is an extension of the results of Mullins and Sekerka who studied the stability of smooth interfaces and were able to determine critical values of various parameters at which such an interface would become unstable with respect to changes of shape on a scale of typically several microns. Their analysis was completely linear and incapable of predicting what happens after the instability occurs. In this proposal the investigators borrow recent developments in the theory of hydrodynamic instabilities and the onset of turbulence. In the part on the theory of spinodal decomposition, the basic theoretical phase is now complete from previous investigations and the mathematical tools which have been developed are ready for detailed applications. (Text Abridged.)

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0029, EXPERIMENTAL STRAIN ANALYSIS
C.A. WALKER, Univ. of Strathclyde, *Glasgow, Scotland, United Kingdom* (DF138670; AF-AFOSR-3007-76)

Knowledge and understanding concerning the fatigue behavior of composite materials is necessary if these materials are to be used safely and efficiently in aerospace structures. The purpose of this effort is to perform experimental strain analysis on composite materials and to investigate the fatigue behavior of notched composite specimens. Payoff is the transitioning of composite technology into the area of aircraft structures. Advantages include lightweight, low-cost and more versatile structures.

The optecord surface strain analysis technique will be employed to investigate the strain field around nucleating and growing cracks in composite specimens and structures. Analysis will be performed to gain a better understanding of the fatigue behavior.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FBEC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0030, HIGH-TEMPERATURE OXIDATION AND CORROSION OF IN-SITU COMPOSITE ALLOYS

J. STRINGER, Univ. of Liverpool, *Liverpool, England, United Kingdom* (DF681000; AF-AFOSR-2785-75)

AF function - advanced propulsion systems. Deficiency - the behavior of directionally solidified eutectic alloys in high-temperature oxidizing environments is not well defined. Research - determination of the oxidation behavior and the interface reactions between phases in various oxidizing environments as a function temperature, phase distribution and volume fraction strengthening phase. How research contributes - to meet the demands of strength stability at the higher operating temperatures of advanced turbine engines, directionally solidified eutectics (in-situ composite) alloys are being developed. However, both the compositions and the microstructures of these alloys suggest poorer oxidation resistance than presently used superalloys. Therefore, a quantitative evaluation of their oxidation behavior as a function of composition and microstructure is a prerequisite of a long- range development program.

Several oxidation tests will be conducted on in-situ composite alloy compositions of technological significance. These tests are (a) oxidation, (b) oxidation following presulfidation, (c) oxidation of salt-coated specimen, and (d) oxidation in Dean apparatus with salt being continuously supplied. Complementary studies will be conducted of the reactions at solid/solid and solid/solid/environment interfaces for the pertinent phases.

ADDENDA: Supporting agency address is: AF Materials Laboratory LLM Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

3.0031, ADVANCED MATERIALS FOR SOLUTION OF SPECIAL PROBLEMS, IMPROVEMENT OF MECHANICAL PROPERTIES OF GRAPHITE FIBERS

S. GOLDFEIN, U.S. Army, Mobility Eqp. Res. & Dev. Com., *Fort Belvoir, Virginia* 22060 (DA0M3721)

Develop a method for improving the tensile compressive and impact strengths of graphite fiber composites for use in bridges, boats, helicopter blades, etc. It is especially applicable to bridges for the 80's program.

An attempt will be to convert the micro ribbons of which the graphite fiber is made into a composite in order to minimize the damage which they sustain by virtue of their movements while under stress. The approach to be used will be the same as the one used to correct for the dry area in the fiberglass, i.e., inject a suitable matrix into the mass converting it from a group of loose members to a well-bonded composite. In order to accomplish this, a catalyzed monomer in the vapor state, e.g., methyl methacrylate, will be diffused into the fiber and then caused to polymerize by heat or other suitable means. The diffusion will be accelerated by the Beatty method of pulsed impregnation of graphite. Other methods of impregnation will comprise treatment with bromine to swell the graphite to make it more permeable, rf reverse sputtering, and reverse electrodeposition.

ADDENDA: Supporting agency address is: MERADCOM Programs Office (MERDC Lab 9000), Mobility Equipment Research and Development Center, Ft. Belvoir, VA 22060

SUPPORTED BY U.S. Dept. of Defense - Army

ENGINEERING

Includes Engineering (general); Communications; Electronics and Electrical Engineering; Fluid Mechanics and Heat Transfer; Instrumentation and Photography; Lasers and Masers; Mechanical Engineering; Quality Assurance and Reliability; and Structural Mechanics. For Related Information See Also Physics.

4.0001, FREE-FLIGHT ROCKET TECHNOLOGY

L.W. LEE, U.S. Army, Missile Res. Dev. & Eng. Lab., *Huntsville, Alabama* 35809 (DA0F1025)

To improve the accuracy of surface-to-surface free-flight rockets. To reduce the cost of surface-to-surface free-flight rockets.

Test a rocket with very low sensitivity to surface winds. Plume effects will be utilized to produce a rocket that is unstable for part of the flight and stable for the rest. Proper aerodynamic tailoring will produce a zero-wind-sensitive rocket.

ADDENDA: Supporting agency address is: MICOM Aeroballistics Directorate, US Army Missile RD&E Laboratory, Redstone Arsenal AL 35809

SUPPORTED BY U.S. Dept. of Defense - Army

4.0002, DISTANCE MEASURING EQUIPMENT (DME)

W.B. WARD, U.S. Army, Advanced Sys. Concepts Office, *Huntsville, Alabama* 35809 (DA0F1111)

A. Perform a DME demonstration using existing DME from the Air Force (ALSS) and the Hawk missile in a surface-to-surface role before the end of FY 77. Six (6) missile flights are planned. B. Captive flight test an improved DME capable of meeting a specified ECM threat before the end of Fy 77 using WSMR drone formation control system (DFCS) as a base. C. Air Force to test the ALSS DME against an ECM threat to provide data on a pulsed DME system to compare with data obtained on a CW DME system by the Army.

Modify the DFCS at WSMR for improved capability to resist jamming. The captive tests will be power scaled such that the present power output can be used while still giving a realistic test for future power increases. Processing gain will be improved by application of the present DFCS adaptive threshold and addition of CFAR (constant false alarm rate). The captive flight tests will be conducted with the airborne unit on a helicopter.

ADDENDA: Supporting agency address is: MICOM Advanced Systems Concepts Office, DRSMI-RF, US Army Missile Command, Redstone Arsenal AL 35809.

SUPPORTED BY U.S. Dept. of Defense - Army

4.0003, RESEARCH ON AN INTEGRAL LOW-COST HIGH-TEMPERATURE TURBINE FEASIBILITY DEMONSTRATOR

R. VERSURE, Garrett Corporation, *Phoenix, Arizona* 85034 (DF456910; F33615-74-C-2034)

This program is directed toward a manufacturing study of a laminated, colled axial turbine design and wheel evaluation program. A manufacturing technique that can produce the required complex internal passages to provide more effective cooling schemes for this class of turbine is the lamination concept. It permits utilization of combined convective and film cooling configurations in small turbines. The turbine is produced from numerous thin laminates that are bonded together. Complex internal cooling passages are formed from a combination of laminate configurations that are initially photoetched from sheet material. When properly stacked and bonded, the resulting component is finish-machined to provide the desired aerodynamic and structural design configuration.

This program is primarily directed toward a continuous manufacturing study of a laminated, cooled axial turbine design and wheel evaluation program. The goal of the program is to manufacture five full-size turbine wheels based upon analysis of various specimen configurations analyzed earlier in the program using waspaloy sheet stock as the base laminate material. The wheels will undergo test evaluation including mechanical properties, static airflow checks, cyclic spin pit endurance growth and burst tests.

ADDENDA: Supporting agency address is: AF Aero-propulsion Laboratory TBC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0004, PHOTO-EFFECTS OF SI MOSFETS

L. FORBES, Univ. of Arkansas, School of Engineering, *Fayetteville, Arkansas* 72701 (DF900220; F19628-75-C-0071)

AF function - infrared imaging and target tracking. Deficiency u lack of detectors suitable for applications employing large-scale arrays. Research - investigation of Ga, In, and Au impurities in silicon. How research contributes - the fundamental behavior of these impurities in silicon and their infrared sensing characteristics in MOSFET structures will permit the fabrication of suitable detector arrays.

Design and fabricate gold-, indium-, and gallium-doped silicon MOSFETS and measure their photoresponse in the up to 3.2 micron, 3 to 5 micron, and 5 to 14 micron regions, respectively.

ADDENDA: Supporting agency address is: Rome Air Development Center ETS, Griffiss AFB, NY 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0005, OPTICAL WAVEGUIDE LENSES

D.B. ANDERSON, Rockwell International Corp., *Anaheim, California* 92803 (DF099670; F33615-75-C-1017)

To develop a technique for making refractive and plane reflective components in optical waveguides. A high-quality, short-focal-length, low f number telephoto lens, a beam expander and a plane-reflecting mirror are to be demonstrated. A method of evaluating waveguide lenses will be devised and applied to the optical components mentioned above. These components will be incorporated into integrated optical circuits designed for coherent optical processing functions.

Individual lenses, telephoto systems, beam expanders and plane- reflecting mirrors will be designed, demonstrated and evaluated for (1) low-index films upon low-index substrates and (2) high-index films upon low-index substrates. The relative index change (nf/ns) should be less than 1.05 for the first case and greater than 1.25 for the second. Possible designs for these components include geodesic lenses, high- index overlays in the form of lenses, hybrid structures of these two and index step variations in the film. Possible approaches of fabrication include sputtering through masks and vacuum deposition through masks. A method of evaluating these components might be contrasting the theoretically possible resolution vs. the experimental results.

ADDENDA: Supporting agency address is: AF Avionics Laboratory DHO Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0006, STUDIES IN TRANSONIC, SUPERSONIC, AND SEPARATED FLOWS USING NUMERICAL METHODS

M. HOLT, Univ. of California, School of Engineering, *Berkeley, California* 94720 (DF010830; AF-AFOSR-2318-72)

Both present and future AF aerospace vehicles will be required to fly at high speeds and have an ability to maneuver at these speeds. This will require that new and improved design methods be developed in such areas as transonic flows, separated flows, reattaching flows, unsteady flows, etc. This research will improve existing prediction methods and develop new analysis for calculating three-dimensional flow fields in transonic and supersonic flight and for separated flows. The method developed for inviscid transonic flow will be extended to general airfoil shapes, lifting airfoils, and bodies of revolution. When it is perfected it will be combined with a boundary layer program so that shock boundary layer interactions on airfoils can be considered. The method of integral relations will be extended to flow fields where separation occurs.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0007, MODULAR DIGITAL SCAN CONVERTER

J. HEARD, Hughes Aircraft Company, *Culver City, California* 90230 (DF096430; F33615-74-C-1126)

To build a breadboard modular digital scan converter which can serve as a test and evaluation unit for synthesis of digital avionics system for existing and future aircraft. Additionally, the breadboard will become an integral part of an in-house simulation facility and will be used in the AFAL/AAA digital avionics information system laboratory 'Hot Bench'.

The breadboard design will be partially based on the results of the modular multisensor display study (PR FY11757325290). The special modules will be designed to meet the needs of DAIS, F-111D, the AC-130 gunship and the remotely piloted vehicle image processor.

ADDENDA: Supporting agency address is: AF Avionics Laboratory AAT, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0008, MULTIPLE BEAM ARRAY

R. TANG, Hughes Aircraft Company, *Fullerton, California* 92634 (DF900680; F19628-75-C-0196)

AF function - Satellite-to-aircraft communication. Deficiency - improved antenna performance, particularly in achieving multiple-beam coverage within limited spatial regions with a high-gain array. Research - investigation of new antenna techniques using array apertures and multiple-beam feed networks. How research contributes - present multiple-beam array techniques utilize closely spaced elements and associate one multiple-beam port with each element. Limited sector coverage allows use of fewer elements and so can reduce array cost and weight.

The approach is to devise and investigate lightweight antenna techniques that are applicable to the problem of forming multiple independent beams within a limited spatial sector. Particular emphasis will be in seeking out innovative concepts that will advance the state- of-the-art in array techniques for multiple-beam sector coverage.

ADDENDA: Supporting agency address is: Rome Air Development Center ETE, Griffiss AFB, NY 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0009, BOUNDARY LAYER TRANSITION

R.E. KAPLAN, Univ. of Southern California, School of Engineering, *Los Angeles, California* 90007 (DF042750; AF-AFOSR-2940-76)

AF function - aerospace vehicles. Deficiency - lack of prediction methods for forces, moments, heat transfer rates, etc., acting on aerodynamic shapes when flow changes from laminar to turbulent. Objective - develop prediction methods which are adequate for predicting the phenomena over a flight vehicle over its entire flight regime. How work contributes - this study will investigate both theoretically and experimentally the area of transitioning boundary layers. Validation of a proposed theory will be examined. Techniques of measurement and calculations will also be developed to learn more about the dynamic modeling of turbulent production.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0010, DYNAMICS OF LARGE STRUCTURAL SYSTEMS

T.R. KANE, Stanford University, School of Engineering, *Palo Alto, California* 94305 (ENG75-18680 A01)

This action provides an additional year of support for continuing grant ENG-7518680.

This research program will investigate the dynamics of large structural systems, such as those encountered in the study of problems involving motions of flexible space vehicles, single-track road vehicles and human beings, with a view toward facilitating both the formulation of governing equations and the extraction of useful information from the equations.

This objective will be accomplished by attempting to formulate approximate theories, by exploiting advantages associated with the use of principal axes of inertia, by employing a recently developed scheme for dealing with eigensystems, and by continuing the development of a computer program that facilitates the identification and rational elimination of negligible terms.

SUPPORTED BY U.S. Natl. Science Foundation

4.0011, ANALYTICAL AND SEMI-NUMERICAL METHODS OF FLOW CALCULATIONS

M.D. VANDYKE, Stanford University, School of Engineering, *Palo Alto, California* 94305 (DF038360; AF-AFOSR-2649-74)

AF function - advanced aerospace vehicles. Opportunity - improvement of present semi-numerical methods used for solving viscous flow problems which are inadequate. Objective - develop and refine two semi-numerical methods concerned with flow calculations of viscous flows. How work contributes - improvement in the capability to make flow calculations for viscous flows will permit more accurate and better designs of advanced aerospace vehicles.

Efforts will be concentrated on developing and refining two semi- numerical schemes - computer extension and improvement of perturbation series, and the method of series truncation. Applications will be made to problems in viscous flow.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0012, AN INVESTIGATION OF THE FLOW DYNAMICS OF UNSTEADY SEPARATED REGIONS

M.S. FRANCIS, U.S. Air Force, Frank J. Seiler Res. Lab., *Colorado Springs, Colorado* 80840 (DF281760)

AF function - technology base. Deficiency - insufficient knowledge of the flow behavior of unsteady separated flow germane to a wing of a maneuvering aircraft. Research - develop a flow model through extensive theoretical and experimental analysis of an unsteady separated region on an airfoil. How research contributes - results will describe the behavior of unsteady separated flow germane to helicopter rotors, aircraft maneuvering at high angles of attack, and jet engine compressors. Abstract - a combined analytical and experimental investigation will be employed to determine the nature and details of the flow field physics in an unsteady separated region above a lifting airfoil. Models employing the concepts of vorticity and mass transfer will be developed to understand and explain the viscous-inviscid interactions and resultant wing loading characteristics. Wind and water tunnel experiments employing a wing with an oscillating spoiler will be used to verify the theoretical results and provide an understanding of the basic physical mechanisms. The extension of these models to various other flow situations may also be considered dependent upon the nature and characteristics of the preliminary results.

ADDENDA: Supporting agency address is: Frank J. Seiler Research Lab NH, USAF Academy, Colo 80840

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0013, WIDE-ANGLE, MULTI-VIEWER INFINITY DISPLAY STUDY

L. SCHAFFER, General Electric Company, *Daytona Beach, Florida* 32015 (DF229100; F33615-76-C-0064)

To develop a design for a wide-angle, multi-viewer infinity display system for use in visual simulation. Current multi-viewer display systems provide a relatively narrow field-of-view. State-of-the-art wide-angle displays are limited to only one viewer. With this study, the technology to provide a continuous wide-angle, color infinity image to the cockpit crew in a flight simulator will be investigated. A display system based on this initial design study is intended to increase the number of missions which can be trained in simulators for bomber-, cargo-, and tanker-type aircraft and will provide more effective training.

Representative visual simulation display requirements for bomber-, tanker-, and cargo-type aircraft have been developed. Those requirements include viewing for all crew members requiring visual contact with the terrain, provisions for mounting on a motion platform, image quality parameters, and color television-type input. Using these requirements, this study effort will develop a design definition and will describe any technical areas which require further research. This study will review current technologies and explore near-future technologies for the basis of selecting a display technique. The main study area will be the optical design of the display system and the feasibility of manufacturing these optical devices. Other areas of study include interfacing the display system with the motion platform, simulator cockpit, and the television image input device. It is anticipated that this study will result in a paper-design and that additional development will be required before this design can be implemented in hardware.

ADDENDA: Supporting agency address is: AF Human Resources Laboratory ASM, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0014, BAND CALCULATIONS ON FERROELECTRIC AND PIEZOELECTRIC PROPERTIES

J.H. HENKEL, Univ. of Georgia, School of Arts & Sciences, *Athens, Georgia* 30602 (DF103610; F33615-75-C-1177)

AF function - electronics, pyroelectric image tubes. Deficiency - inability to calculate the electronic properties of ferroelectric, piezoelectric and pyroelectric coefficients from first principles. Research - the use of first-principles methods to calculate the ground- state properties and excitation energies of ferroelectric crystals will be made. Special attention will be devoted to obtaining accurate enough charge densities such that the dipole moment of the investigated ferroelectrics will be within experimental error. Also the calculation of the piezoelectric and pyroelectric coefficients of these ferroelectrics will receive special attention. How research contributes - once one is able to calculate the piezoelectric and pyroelectric properties of a crystal, one can predict the image tube capability without developing the large number of materials. Thus one can tell which substance should be developed and used in these tubes, which in turn saves a large amount of time and money.

ADDENDA: Supporting agency address is: AF Avionics Laboratory DHR, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0015, COMPRESSOR RESEARCH FACILITY

J. UNTZ, Cadre Corporation, *Atlanta, Georgia* (DF455770; F33615-73-C-2030)

The objective of this program is to contribute to the advance of the state-of-the-art of turbine engine compressor technology by (1) supporting exploratory and advanced development of compressor design, (2) improve compressor component characteristics, (3) determine steady- state and dynamic air flow characteristics, and (4) determine effects of steady-state and transient air flow on compressor performance.

The approach is a three-contract, turnkey effort having five (5) phases. Phase I - detail design, phase II - equipment procurement, phase III - installation, phase IV - inspection and maintenance of existing equipment, phase V - test and inspection. AFAPL utilizes a 10-man team to monitor the program (see accession 455770 AFAPL in-house 30660412).

ADDENDA: Supporting agency address is: AF Aero-propulsion Laboratory TBC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0016, EQUATORIAL RADIO FADING

J.R. KOSTER, Univ. of Ghana, *Accra, Ghana* (DF241960; AFAFOSR-2628-74)

AF function - communications, radar. Deficiency - signal fading causes high error rates. Objective - to determine the nature and extent of the destructive effects of the irregular equatorial ionosphere on signals from communications and navigation satellites. How research contributes - results are used to predict times and conditions of outages. This work extends earlier 136, 254, 140 and 360 mHz observations and analyses. Data will be used to determine propagation characteristics of communications channels. Results will be used by GPS/NAVSTAR, AFSATCOM and FLEETSATCOM systems designers.

The approach is to record and analyze VHF/UHF radio signals transmitted by satellites to illustrate and quantize destructive ionospheric effects. Data reduction and analysis are accomplished by the grantee; the coded data are also furnished for AFGL analysis. This year the work will stress analysis of group delay observations taken using the ATS-6 satellite during the year June 1975 - June 1976.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory PH, L.G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0017, GRAPH THEORY AND COMBINATORICS WITH APPLICATIONS TO DIGITAL SYSTEMS AND NETWORKS
S.L. HAKIMI, Northwestern University, School of Technology, *Evanston, Illinois* 60201 (DF043670; AF-AFOSR-3017-76)

Air Force function - recent major advances in hardware technology for communications and other Air Force avionics systems should be exploited through the application of sophisticated mathematical methods of analysis and design. Deficiency - development of these methods is not keeping pace with hardware capabilities, to the detriment of system performance. Objective - the objective of this research program is to use graph theory and combinatorics to develop analysis and design methods for application to communications and digital network problems. How work contributes - these design methods would enable improved efficiency and performance for important Air Force systems.

Research will be conducted in four areas. In communications, new problems in location theory and network reliability and delay characteristics will be investigated. In coding, the ideal decoding of graph-theoretic block codes will be studied, as well as variable-length codes. In digital systems and computer applications, information theoretic concepts will be used for identifying faulty subsystems. Petri nets for computer modelling and Dilworth's theorem for software validation will be investigated. In graph theory, combinatorial optimization, chromatic polynomials and extremal problems in digraphs will be studied.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NM Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0018, COHERENT STRUCTURE OF A TURBULENT BOUNDARY LAYER
C.R. SMITH, Purdue University, Purdue Research Foundation, *Lafayette, Indiana* 47907 (DF043850; F44620-76-C-0099)

AF function - advanced aerospace vehicles. Opportunity - develop a better understanding of the behavior of turbulent flows. Objective - to develop a better understanding of turbulent boundary-layer structure and its interactive behavior. How work contributes - the information to be obtained from this research is necessary both in the development of improved methods for turbulent boundary-layer control and for the development of improved a priori analytical prediction techniques for turbulent boundary-layer flows.

The research will be a detailed multi-phase experimental study of the quasi-ordered flow structure of a turbulent boundary layer. In phase one, the characteristics of the large-scale transverse-vortex structure associated with turbulent boundary layers and the interactive effect it has on the wall-layer structure will be determined. In phase two, pointwise measurements via hot-film and hot-wire anemometers will be accomplished. The third phase will be to develop a mathematical model of the traveling structure. Finally, in phase four, detailed measurements will be made in both a water tunnel and wind tunnel, thus providing a direct mechanism for correlation of the physical structure and behavior of turbulence with traditionally measured properties.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0019, SPECTRAL AND TOTAL EMISSIVITY AND REFLECTIVITY AT HIGH TEMPERATURES
R.E. TAYLOR, Purdue University, Purdue Research Foundation, *Lafayette, Indiana* 47907 (DF043040; AF-AFOSR-2967-76)

AF function - weapons delivery. Deficiency - development of laser- hardened materials for aircraft surfaces and system components is hampered by lack of high-temperature data on thermophysical properties of most solids of possible interest. Objective - to obtain reliable experimental values of emissivity and reflectance as functions of wavelength (1 to 12 micrometers) and temperatures (800 to 1800K) for selected key metallic and nonmetallic materials. How work contributes - provides needed data for evaluation of candidate development materials, and will result in predictive methods for higher temperatures and related substances.

A unique measurement system already developed will be used for metallic samples: modifications must be developed and experimentally verified for measurements on non-metallic substances. Special effort will be placed on the temperature region fifty degrees below and above the melting point.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0020, THERMO-MECHANICAL STRESS ANALYSIS OF ADVANCED TURBINE BLADE COOLING CONFIGURATION
F.J. RIZZO, Univ. of Kentucky, School of Engineering, *Lexington, Kentucky* 40506 (DF040950; AF-AFOSR-2824-75)

AF function - to contribute to the sum of total knowledge regarding thermal effects for engine components of modern aerospace vehicles. Deficiency - there is a lack of scientific understanding concerning heat transfer for complex and advanced Air Force turbomachinery. Objective - this research effort will attempt to fully evaluate stress distributions for a transpiration-cooled gas turbine engine blade. How work contributes - if more is known about the problem of thermo-mechanical stresses in the vicinity of a cooling hole for a turbine blade, better Air Force flight systems and components will surely evolve.

Through the use of the boundary integral equation method (BIE), the problem of a thermo-mechanical stress near a cooling hole in a turbine blade is analyzed. Manufacturing 'realities' of multiple holes, temperature-dependent elasticities, anisotropic effects, viscoelastic effects and the influence of cracks are also considered.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0021, STRUCTURAL MODEL EVALUATION
W.J. TAYLOR, U.S. Army, Ballistic Research Labs., *Aberdeen Proving Ground, Maryland* 21005 (DA0K4494)

A comparison of good-quality experimental structural response data for large plastic deformations with BRL-developed computer code results. Decide on the most suitable code to use for the analysis of the blast response of helicopters, aircraft and tank bottoms.

Strain and deflection measurements made on structural elements that are shock loaded by air and chemically driven shock tubes will be compared with results produced by codes that are designed to predict such responses. Edge conditions and types of engineering materials will be varied in order to fully exercise the capabilities of the codes selected for evaluation. The program will focus on the ability of the code to perform in the elasto-plastic to fracture stress region.

ADDENDA: Supporting agency address is: DARCOM Ballistic Research Labs, Aberdeen Proving Ground, MD 21005

SUPPORTED BY U.S. Dept. of Defense - Army

4.0022, ULTRASONIC DETECTION OF FATIGUE DAMAGE IN AIRCRAFT COMPONENTS
R.E. GREEN, Johns Hopkins University, School of Engineering, *Baltimore, Maryland* 21218 (DF043500; F44620-76-C-0081)

AF function - Air Force advanced aerospace vehicles require increased design emphasis on durability and inspectability. New techniques for nondestructive evaluation (NDE) are needed to reduce O and M costs. Deficiency - cost factors projections for Air Force advanced systems are unacceptable. New inspection techniques coupled with fracture mechanic analysis methods are needed to reduce Air Force costs. Objective - the objective of this research is to extend laboratory research involving ultrasonic attenuation and acoustic emission to correlation with typical Air Force hardware. How work contributes - this research contributes to the Air Force program seeking to enhance flight structure reliability and durability.

Techniques of ultrasonic attenuation and acoustic emission will be used in this research. Experimental techniques and monitoring systems will be investigated to correlate crack initiation

and crack characteristics. Correlation will be studied between laboratory specimens and actual aircraft components.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0023, THREE-DIMENSIONAL TURBULENT BOUNDARY LAYER FLOWS

W.L. MELNICK, Univ. of Maryland, School of Engineering, *College Park, Maryland* 20740 (DN223795; N00014-75-C-0613)

Though three-dimensional turbulent flows occur over large regions of aircraft and missiles for many flight conditions, such flows are poorly understood. In addition, present predictive methods are based on extremely inadequate experimental information. It is the purpose of this task to provide the necessary detailed measurements in a low-speed, three-dimensional turbulent boundary layer which are required for the formulation of a meaningful turbulent phenomenological model.

The study of turbulent flows for aerodynamic and hydrodynamic predictive purposes is the study of phenomenological turbulence. Crucial to such studies are experimental data to evaluate closure models for the governing equations. The proposed program is experimental, aimed at obtaining detailed measurements of both time mean and fluctuation quantities in a thick, turbulent boundary layer. The experiments will be conducted on the side wall of a low-speed wind tunnel. The three-dimensional flow will be developed by installing a 30-deg swept wing- like model on the wall of the tunnel. Detailed measurements will be made of the relaxing flow field downstream of the model. Measurements will include pressures and flow angularity characteristics; turbulent velocity fluctuations will be made with hot wire probes.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

4.0024, BASE ANTENNA FLIGHT INSTRUMENTATION (BAFI)

R. PARADIS, U.S. Army, Harry Diamond Laboratories, *Hyattsville, Maryland* 20783 (DA0F5636)

The measurement of the characteristics of a base-mounted antenna in a plasma environment.

A radar instrumentation system is employed to measure plasma loss and four probe reflectometers are employed to measure the complex impedance of each antenna element throughout the reentry environment during an actual vehicle reentry.

ADDENDA: Supporting agency address is: USAF Space and Missile System Organization, Air Force Systems Command, World Way Postal Center, P.O. Box 92960 Los Angeles, CA 90009

SUPPORTED BY U.S. Dept. of Defense - Army

4.0025, EVALUATION OF ADVANCED SENSORS

B.R. CAPONE, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF246340)

AF function - reconnaissance, satellite surveillance, tactical operations. Deficiency or opportunity - high cost and low reliability of infrared detectors limits usage. Objective - characterization of prototype thermal imaging sensors using Schottky-barrier devices; integration of advanced sensors into vacuum and solid-state camera devices. How research contributes - the development of advanced sensors will impact on a broad range of Air Force systems through improved performance and cost reduction. The incorporation of these devices into vidicon-type operation has the advantage of making them cheaper and less subject to failure due to mechanical difficulties than some existing systems such as the present FLIR system.

The necessary properties of Schottky-barrier retinae that enable storage mode operation will be investigated. These properties include quantum efficiency, leakage current, operating temperature and uniformity of response. This study will also include the effects on these properties by integration into vidicon-type devices.

ADDENDA: Supporting agency address is: AF Cambridge Research Laboratories LQ, L.G. Hanscom AFB, Bedford, MA 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0026, MICROWAVE LASER PROPAGATION IN TURBULENT MEDIA

R.L. FANTE, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF900430)

AF function - weapons delivery. Deficiency - adequate theories do not exist for calculating the propagation and scattering of electromagnetic waves in strong turbulence. Objective - to develop methods for calculating the propagation characteristics of laser beams in turbulence and for calculating the radar cross section of turbulent plasma. How research contributes - these studies will be applicable to the analysis of optical systems and to the detection of the turbulent wake of reentry vehicles.

We plan to use transport methods and techniques based on the Markov approximation to develop a theory for the propagation characteristics of an electromagnetic wave in a strongly turbulent medium. This will then be applied to determine the radar cross section of turbulent wakes and plumes, and to the calculation of various properties of laser beams in atmospheric turbulence.

ADDENDA: Supporting agency address is: Rome Air Development Center ETE, Griffiss AFB, NY 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0027, THIN-FILM TECHNOLOGY FOR DEVICE AND COMPONENT FABRICATION

A. GOLUBOVIC, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF901020)

AF function - surveillance, weapons delivery, weaponry. Deficiency - various devices and systems based on semi-conducting and electrooptical materials require special refinement in electronics and optics not available through traditional technology. The stability and reliability of devices depends strongly on the complexities of the interaction between individual component and materials and their interface. These complex fundamental parameters are not well established. Objective - development of techniques for preparation and evaluation of single and multilayered films, applied as device passivating and hardening coatings for electrooptic applications. New methods for combined surface passivation and hardening (ionizing or laser) or semi-conducting and optoelectronic devices will be investigated. A coordinated program of thin-layer coating methods will include thermal and electron beam, vacuum and ultra-high vacuum sublimation, and deposition by RF sputtering and reactive sputtering. How research contributes - research contributes to the development of necessary new techniques for surface preparation and coatings of materials which are integral parts of devices, electrooptic systems, laser- or radiation-hardened systems, and integrated circuits.

Deposition parameters, e.g., temperature, pressure, rate of deposition, adhesion to substrates, chemical stability, stoichiometry of deposited layers, will be studied and optimized. Additional information will be obtained by monitoring residual gases by means of a mass analyzer.

ADDENDA: Supporting agency address is: Rome Air Development Center ETS, Griffiss AFB, NY 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0028, DEVICE STRUCTURE AND MATERIALS EVALUATION

N.E. PICKERING, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF247030)

AF function - communications and surveillance. Deficiency - solid- state devices operating at microwave frequencies in current Air Force systems are unreliable. Objective - the goal of this work is to determine the effect of defect structure and surface morphology on device, components, and system reliability under both active and passive operating conditions. How research contributes - this research will result in an understanding of the

failure mechanisms occurring in microwave devices and thereby lead to greater system reliability.

We will use the scanning electron microscope (SEM) with its associated attachments such as hot stage, X-ray analyzer, and active mode testing apparatus to investigate surface structure and defects. The use of new interpretive techniques including Coates patterns or active emission testing will help in the evaluation of materials and devices. The analysis of devices will be done in a step-wise manner during device processing, so that the introduction of defects or inclusions can be related to a particular stage of device fabrication.

ADDENDA: Supporting agency address is: AF Cambridge Research Laboratories LQ, L.G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0029, NUCLEAR RADIATION EFFECTS AND HARDENING OF CHARGE COUPLED DEVICE ARRAYS

W.M. SHEDD, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF901680)

AF function - nuclear weapons, defense and delivery, navigation and guidance, reconnaissance, and satellite communications. Deficiency or opportunity - missile delivery and missile defense vehicles are not sufficiently hardened. Objective - solid-state devices will be studied for both permanent effects and transient effects, including rapid anneal. Techniques for hardening will also be investigated. How research contributes - the results to be obtained will provide the necessary understanding and techniques for extending today's radiation-hardening technology and will help to establish the base for meeting the radiation-hardening needs of the next generation of weapons systems.

Almost all of the radiation effects and hardening efforts for MIS structures have been devoted to problems associated with the interface between the silicon and the gate insulator. Two other interfaces, namely, the dielectric substrate/silicon interface and the gate electrode/gate insulator interface, play an important role in the overall radiation sensitivity of MIS structures. The role of these two latter interfaces in radiation-hardened structures will be studied and characterized. Junction field effect transistors, fabricated in SOS structures, will be used to characterize the dielectric substrate/silicon interface.

ADDENDA: Supporting agency address is: Rome Air Development Center ETS, Griffiss AFB, NY 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0030, ANALYSIS AND TEST OF BEVERAGE ANTENNAS

R.W. KING, Harvard University, School of Engineering, *Cambridge, Massachusetts* 02138 (DF901650; F19628-76-C-0057)

AF function - aerospace antenna systems. Deficiency - arrays of beverage antennas are not sufficiently characterized at present to permit their full use over varying ground conditions in radar detection systems. How research contributes - provides an analysis tool in the form of an experimentally verified antenna current distribution as a function of element spacing, element height and ground constants.

The effort involves modeling the earth environment beneath beverage antennas, scaling frequencies of operation and under closely supervised laboratory conditions, measuring antenna current, driving point impedance, gain and efficiency as the model antenna is varied in height above the surface and the ground constants are varied to simulate a variety of real earth conditions. The measurements are used to validate a current expression that can be used under most ground and height conditions.

ADDENDA: Supporting agency address is: Rome Air Development Center ETE, Griffiss AFB, NY 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0031, BASIC INSTABILITY MECHANISMS IN CHEMICALLY REACTING SUBSONIC AND SUPERSONIC FLOWS

T.Y. TOONG, Mass. Inst. of Technology, School of Engineering, *Cambridge, Massachusetts* 02139 (DF005060; AF-AFOSR-2619-74)

For weapon delivery and defense and close air support, advanced air-breathing combustion engines and high-specific-power chemical explosive weapons are required. This program responds to RO 5.2 and 6.3 and encompasses study of instability mechanisms basic to many problems involving chemically reacting subsonic and supersonic flows, e.g., problems related to combustion instability, chemical noise, detonation wave structure and stability and initiation, turbulence spectra in reacting flows, etc. Results will aid in design and development of practical combustors and chemical explosive (e.g., FAE) devices, and in alleviation of combustion instability and noise pollution. Included will be studies of (1) chemical effects on generation and amplification (or attenuation) of acoustic waves and their propagation, (2) chemical effects on generation of vorticity, (3) chemical effects on interactions among the three basic fluctuation modes in turbulence, viz, sound, entropy, and vorticity, (4) energy transport mechanisms among the fluctuation modes with and without chemical reaction, (5) initiation requirements of detonations. In the experimental investigation, both Schlieren visualization and microphone monitoring will be utilized. Chemical effects will be studied in hydrogen-chlorine-diluent mixtures for different acoustic amplitudes and frequencies, mean flow conditions, chemical compositions, initial pressures, and ultraviolet radiation intensities. Theoretical analyses will interpret the experimental results, with emphasis on elucidating the basic energy-transport mechanisms involved in the interactions between chemical reaction and turbulence.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0032, DISTRIBUTIVE PARAMETER SYSTEMS FOR FLIGHT CONTROL

E.B. LEE, Univ. of Minnesota, School of Engineering, *Minneapolis, Minnesota* 55414 (DF018720; AF-AFOSR-2243-72)

Air Force function - the effectiveness of most complex modern Air Force systems depends in large measure upon how well they are controlled. Deficiency - modern methods for analyzing and synthesizing control systems are obscured in a myriad of mathematical abstractions incomprehensible to practical engineers. Objective - the objective of the proposed research is to further develop and clarify the infinite dimensional control theory. How work contributes - this research will make modern theory more useful in the design of controllers for aerospace systems.

Research in this program will include three general topics: the development of transfer-function (frequency domain) theory for infinite dimensional controlled systems, refinements of the basic results on decoupling theory to include various approximations and results for systems with nonlinear models and time delays, and the development of the theory of quadratic forms for the time-delay quadratic cost problem. One approach for problems with functional differential equation models will be to use an abstract representation for the system and cast everything in terms of an operator theory, seeking simplified results for optimization theory and identification. The decoupling theory work will be an investigation of the trade-offs available between system response, control magnitudes, and degree of decoupling.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NM Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0033, IMPROVED BALLOON SYSTEM

J.B. MUNSON, G.T. Schjeldahl Company Inc., *Northfield, Minnesota* 55057 (DN223546; N00014-72-C-0494)

To develop a lightweight, inexpensive scientific balloon material that is strong enough to withstand the low pressures and wide ranges of low temperature associated with lengthy stratospheric flight conditions. Providing that seam sealing techniques and appendage ducts can be successfully accomplished, the polyethylene with nylon scrim (poly- plus), recently developed, appears capable of reaching this objective. Thus will the larger goal of being able to expose sensors at very high altitudes for long periods in order to better define the earth-space coupling as it affects Navy communications and weapon control and detection be attained.

In order to bring the work to an orderly conclusion the contractor is preparing a summary status report to document the current status of poly-plus and define the problem areas to be solved before poly-plus can be accepted as a balloon fabrication material.

ADDENDA: Supporting agency address is: Office of Naval Research 466, Arlington, Va. 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

4.0034, AUTOMATION OF I C PROCESS CONTROL EQUIPMENT

G. SMITH, Electronic Associates Inc., *Long Branch, New Jersey* 07740 (DF735940; F30602-75-C-0249)

The objective of this program is to automate acquisition and reduction of data from advanced analytical instruments used to study integrated circuit processing. An improvement in the reliability of integrated circuit processing will increase the yield and reliability of integrated circuits used in Air Force electronics.

The approach will be to acquire necessary data acquisition and processing equipment and then automate a capacitance-voltage measurement system, an Auger spectrometer, and a spreading resistance probe. Advantages of such a technique include decreases in man-power expenditures, increased accuracy, and 'real-time' detailed analysis.

ADDENDA: Supporting agency address is: Rome Air Development Center RBR, Griffiss AFB, NY 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0035, FUNDAMENTAL RESEARCH IN TURBULENT MODELING

C. DONALDSON, Aeronautical Res. Associates, *Princeton, New Jersey* 08540 (DF042850; F44620-76-C-0048)

AF function - advanced aerospace vehicles. Deficiency - lack of understanding about turbulence and turbulent flows. Objective - modeling of turbulent flows with particular emphasis placed on terms dependent on pressure fluctuation. How contributes - an understanding of pressure fluctuations and its effect on turbulent flows is very important in understanding high-speed flows. It also implies an understanding of noise radiated by turbulent flows. Understanding of this phenomenon will be directly applicable to the design of advanced aerospace vehicles.

A theoretical program will be established to reevaluate the modeling of turbulent flows through invariant, second-order closure in light of the new concepts proposed by Yates and Sandri. Particular emphasis will be placed on modeling of terms containing the pressure fluctuation.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0036, SIGNAL PROCESSORS FOR USE IN AIR FORCE AVIONICS SYSTEMS

B. LIU, Princeton University, School of Engin. & Appl. Sci., *Princeton, New Jersey* 08540 (DF023740; AF-AFOSR-2101-71)

Signal processors are a critical part of Air Force electronics systems used for communication, flight control, navigation and guidance, fire control, and reconnaissance and surveillance, as well as for more ordinary data processing functions. Digital signal processors are of increasing importance because of the Air Force program to develop an integrated digital avionics system as a means to greatly increase the versatility of future generations of combat aircraft. This continuing work unit is directed toward the support of such programs through the development of new engineering design and analysis methodology for the realization of digital filters, FFT devices and other signal processors having improved characteristics of speed, accuracy, size, weight, power consumption, and/or complexity and for solving related signal processing problems. Current effort is focused on three problem areas: (1) determining the minimum number of bits required to achieve a prescribed accuracy in digital signal processors, (2) extending a new approach to implementing these processors which exploits new developed electronic technology, and (3) eliminating the limiting assumption of independent noise samples and Gaussian noise characteristics conventionally used in signal processing, detection, and estimation.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NM Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0037, TURBULENT FLOW FIELDS

G.L. MELLOR, Princeton University, School of Engin. & Appl. Sci., *Princeton, New Jersey* 08540 (ATM75-19326)

An experimental capability has been developed at the Geophysical Fluid Dynamics Laboratory, Princeton University, which can continue to produce new data which are relevant to the understanding of turbulent mixing and internal wave processes in the atmosphere and oceans.

The objectives of this research are to perform the following experiments: (1) Measurements of the process associated with the sinking of negatively buoyant bubbles in constant density and stratified flows. (2) Measurements of the wave spectra beneath a convective layer to verify the theoretical predictions that a frequency peak exists close to the Brun-Vaisala frequency. (3) Measurement of the velocity and density field of a homogeneous, salt-stratified turbulent flow. The turbulence is initiated by a towed grid and the subsequent decay history is observed. We will lean primarily on a particle tracer measurement technique which has been developed at Princeton. (4) Measurements of internal waves in a salt-stratified body of water forced from above a turbulent mixed layer of (nearly) fresh water.

SUPPORTED BY U.S. Natl. Science Foundation

4.0038, ANHARMONIC OSCILLATOR LASERS

J.A. SMITH, Princeton University, School of Engin. & Appl. Sci., *Princeton, New Jersey* 08540 (DF036890; F44620-73-C-0059)

AF function - systems based on flowing gas lasing media are a potentially important addition to the Air Force mission. Alternatives to e-beam stabilized discharge systems are extremely attractive provided that they can be shown to operate at high power loading levels. Opportunity - the experimental effort is directed toward the development of a double-discharge system in a supersonic flow channel. The simplicity of this discharge scheme makes it an attractive alternative to e-beam stabilized systems. Objective - the main objective is to establish by a combination of experimental exploration and theoretical modeling of the mechanisms responsible for the double-discharge process so that scaling laws with respect to size, pressure and power loadings can be determined. Contributions - theoretical developments will attempt to formulate a self-consistent description of the double-discharge process, with special emphasis on scaling laws with respect to power loading. The experimental effort will provide detailed measurements and will serve as a guide to the theoretical models. This research has the potential for filling in many gaps in the experimental data as well as for constructing more powerful theoretical tools for understanding.

A supersonic (Mach 4) tunnel with a double-discharge electrode configuration has been constructed. The first phase of the program consisted of determining the flow quality and the mass-flow, pressure boundaries of the operating range of the device. This was followed by a preliminary investigation of the electrical properties of the discharge. Experimental modifications have been made. The future work will determine electrical characteristics of the device as a function of the various operating parameters. A simple analytical solution to the quasi- steady master kinetic equations for the vibrational population distribution of anharmonic diatomic molecules has been derived and important results obtained. Extension to mixtures involving several vibrationally active species is in progress. Additional parameters characterizing the cross-section shapes have to be introduced. The immediate goals are to achieve correlation over as wide a range of mixtures and e/ns as possible. The longer range goal is to incorporate these results into the overall theoretical description of the discharge characteristics observed in the experimental program. (Text Abridged.)

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0039, UNSTEADY BOUNDARY LAYER FLOWS
J.G. HALL, State University of New York, Graduate School, *Albany, New York* 12203 (DF039360; AF-AFOSR-2719-74)

AF function - aerospace vehicles. Opportunity - of prime interest for the future will be the ability of the scientist and engineer to model flows with unprecedented accuracy, thereby minimizing the costly consequences of small errors in estimating the static and dynamic loads over a wide variety of shapes and configurations. The major communicating link between a body and the moving fluid in which it is immersed is the boundary layer. An important unresolved feature of this boundary layer is its stability and transition to turbulence in response to time varying (unsteady) inputs such as might result from a maneuver. While the mean characteristics of the unsteady laminar boundary layer have been studied to some extent and are believed to be reasonably well understood, the transition of this laminar boundary layer to turbulence and the turbulent boundary layer which develops from this unsteady, initially laminar flow have not been look at in any detail. A unique way of studying, experimentally, the stability of unsteady viscous flows, particularly of transient as distinct from periodic flows, is by use of a Ludwieg tube as anticipated in this research effort. Objective - to study analytically and primarily experimentally the stability and transition characteristics of unsteady laminar wall boundary layers as well as the features of the turbulent flow at long times following passage of a finite wave over an observed measuring station in a Ludwieg tube. How work contributes - a major objective of this research effort will be to exploit the great flexibility of the expansion (Ludwieg) tube as regards independent variations of pertinent flow conditions which determine the basic similitude parameters.

The experimental program has concentrated on obtaining transition- time data by thin-film detection for a range of the parameters involved. It appears desirable to employ other diagnostic techniques as well. For that purpose a special hot-wire probe is under construction and will be used to sense velocity fluctuations within the boundary layer itself. The theoretical investigation of the expansion-wave boundary layer stability is based on a linearized small-disturbance analysis using the method of multiple scales.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0040, ROTOR BEARING DYNAMICS DESIGN TECHNOLOGY
C.H. PAN, Shaker Research Corporation, *Ballston Lake, New York* 12019 (DF458690; F33615-76-C-2038)

Update current AFAPL-TR-65-45 series to reflect state-of-the-art advances and to clarify certain sections.

Review current volumes, literature, and practice to establish areas for update, correction, and/or additions. Rewrite and restructure the guides to reflect and improve ease of use. Add volume on gas-lubed foils and pneumomechanical critical speed control. Provide for systematic update.

ADDENDA: Supporting agency address is: AF Aero-propulsion Laboratory SFL, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0041, GROWTH OF HIGH-QUALITY CD A
G. LOIACONO, North Amer. Philips Corp., *Briarcliff Manor, New York* 10510 (DF100970; F33615-75-C-1202)

To establish the conditions for repeatable growth of high-optical- quality, low-loss crystals of Cd A in large sizes. This program covers the investigation of crystal growth conditions of Cd A and the characterization of resultant crystal samples. The growth of deliverable crystals representative of the improved state of knowledge of the growth process at the end of the program is also involved.

The contractor shall investigate variations in solution growth conditions in order to determine the optimum conditions for growth of highly deuterated, low-loss, high-optical-quality crystals. Typical problems to be addressed are tapering during growth, flawing, and twinning. These problems are thought to be related to the exceptionally high supersaturation encountered in Cd A growth in D2O. Methods of increasing the D2O/solute ratio must be investigated.

ADDENDA: Supporting agency address is: AF Avionics Laboratory DHO, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0042, STATIC AND DYNAMIC BEHAVIOR OF NON-CIRCULAR CYLINDRICAL SHELLS
J. KEMPNER, Polytechnic Inst. of New York, School of Science & Engin., *Brooklyn, New York* 11201 (DF038490; F44620-74-C-0047)

Air Force function - improvements in the structural efficiency of Air Force flight vehicles will continue to be required to meet future performance enhancements. Stiffened shell structures represent major portions of Air Force flight vehicles. Deficiency - incomplete understanding and predictive capability exists for describing the nonlinear buckling and vibrational behavior of stiffened cylindrical shells. Objective - the objective of this research is to analyze the postbuckling behavior and vibrational characteristics of stiffened shells in order to achieve predictive methodologies which accurately represent observed phenomena. How work contributes - results of this research will improve future vehicle designs and provide independent sources of data for use by general computerized numerical techniques.

Nonlinear postbuckling analysis of oval shells under combined axial compression and bending couples will be conducted. Free vibration of general cylindrical shells will be studied which consider several classes of support boundary conditions. Solution procedures relying on the theory of shells, integral theory and eigenfunction expansions will be utilized during the course of this research.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0043, NOVEL CHEMICAL LASER SYSTEMS
T.A. COOL, Cornell University, School of Mechanical Engin., *Ithaca, New York* 14850 (DF037150; AF-AFOSR-2550-73)

AF function - future Air Force operations in reconnaissance, communications, weaponry, and other areas require new laser systems of varied output frequencies of shorter wavelength, increased power at lower weight. Deficiency - a lack of suitable chemically pumped lasers of high efficiency with output wavelengths of less than two micrometers. Objective - examine various techniques in an attempt to develop a prototype electronic transition laser pumped directly by exothermic chemical reactions. The goal is to produce laser action on systems that radiate in the near IR, visible or ultraviolet regions of the spectrum. How work contributes - various techniques are formulated and developed to produce metal atom vapors for reactions with oxidizers. The exothermic reactions produce excited states of molecules and atoms that may result in population inversion - a prerequisite for lasing action.

Use of high-temperature oven, shock tube, nozzle array and laser cavity to study exoergic chemical reactions involving metal atoms and oxidizers including thallium, scandium and yttrium, among others, to look for laser action from electronic transitions in atom and molecular systems. Examine the possibility of employing the experimental apparatus to produce a pulsed rare-gas monohalide laser.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NC Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0044, OPERATIONAL RELIABILITY EXPERIENCE TO IMPROVE RELIABILITY OF AF ELECTRONIC SYSTEMS
E. FLORENTINO, U.S. Air Force, Rome Air Development Ctr., *Rome, New York* 13442 (DF707570)

This in-house effort will be concerned with (a) the collection from all Air Force data sources of information on the reliability of Air Force electronic comunication, comand and control, surveillance, navigation, and display equipment; and (b) analysis of these data to determine the present field reliability of these items and comparison of predicted, measured, and observed field failures.

The field failure data collected will be analyzed to define the scope and impact on the reliability problem. Principal 'contributors' such as parts, equipment design, and human influences will be investigated. The influence of major offenders or 'weak links' in the system will be defined. Effects of equipment characteristics such as power output, complexity, and other factors on reliability will be determined. Reports on the above information will be published and disseminated to interested personnel.

ADDENDA: Supporting agency address is: Rome Air Development Center RBR, Griffiss AFB, NY 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0045, GALLIUM ARSENIDE DEVELOPMENT FOR HIGH-POWER MICROWAVE SOURCES

J.N. MILAN, U.S. Air Force, Rome Air Development Ctr., *Rome, New York* 13442 (DF742190)

This effort is to grow and characterize high-quality GaAs with complex doping structure for Read Impatt devices and to fabricate and test the devices. The Read Impatt diode is a relatively new structure that holds much promise for future Air Force communications and radar systems requiring microwave power. This effort will complement another RADC program for 'high-efficiency solid-state c-band generator' that was started in response to an ADTC TN. A secondary objective of the effort is to obtain data on the quality of GaAs substrates commercially available and to interact with other AF organizations to improve the quality of GaAs for microwave devices. The material grown under this effort will also be supplied to other AF labs and to RADC contractors including Cornell University and the University of Michigan for their evaluation and use in device fabrication.

The GaAs layers will be grown in the house by the liquid phase epitaxial technique. Initially the horizontal system will be used with a multiple well sliding boat arrangement so that several layers of different dopings can be grown in a single run. The material will be characterized in RADC and by other AF labs. Drs. Eastman and Lee of Cornell University will provide technical support as part of contract F30602-74-C-0001.

ADDENDA: Supporting agency address is: Rome Air Development Center OCT, Griffiss AFB, NY 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0046, MEMORY FOR RADAR

G. AMELIO, Fairchild Camera & Instr. Corp, *Syosset, New York* 11791 (DF092230; F33615-73-C-1044)

The digital approach to high-resolution synthetic aperture radars requires large amounts of memory for both the radar processor and scan converter. Minimization of the initial cost as well as the total cost of ownership of such systems requires that they be based on an extremely low-cost memory device which is reliable, small in size, and dissipates little power. The objective of this program is to develop an extremely low-cost CCD shift register memory chip which can be configured into SAR processors and scan converters. The low-cost requirement necessitates the development of a reliable memory device which has widespread applications in addition to radar systems and which eventually will be made available on the commercial memory market.

A 32k bit CCD memory chip will be developed with an access time sufficiently short to allow widespread military and commercial use. During this two-year program the following tasks will be performed: (1) analysis of memory system designs and their influence on chip organization (6 mos), (2) design and fabrication of the memory chip and the required intermediate test structures (15 mos), and (3) the design and fabrication of a 100k bit memory module (3 mos). A line-addressable random-access memory (LARAM) chip organization has been chosen as the best candidate vehicle for this program. The program will result in the feasibility demonstration of the CCD memory chip and module, and the generation of sufficient applications data to permit the design of various radar memory systems.

ADDENDA: Supporting agency address is: AF Avionics Laboratory DHE, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0047, COMMUNICATIONS - ELECTRICAL PROPERTIES OF ION-IMPLANTED GALLIUM ARSENIDE

M.A. LITTLEJOHN, Univ. of North Carolina, School of Engineering, *Raleigh, North Carolina* 27607 (DN475218; N00014-75-C-0827)

Advanced Navy electronic systems will use components fabricated from new materials making use of new techniques. Gallium arsenide is a semiconductor which offers increased capability in electron devices and the technology and physics must be understood and developed for fabricating devices in this material.

The phenomena associated with the process of ion implanting gallium arsenide (GaAs) with impurities are not understood. The effects of implantation-induced structural formations have not been assessed. The investigator will use techniques such as transmission electron microscopy (TEM), Auger electron spectroscopy (AES), photoluminescence, and various electrical measurement techniques to characterize the properties of implanted layers in GaAs. Sulfur, beryllium, magnesium tellurium, and zinc will be implanted under various conditions of temperature and fluence. Several protecting encapsulating layers will be applied and annealing cycles carried out. Resulting structural information from TEM will be correlated with chemical data (AES) and with the electrical measurement data.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

4.0048, NETWORK ANALYZER

J.E. ADAIR, U.S. Air Force, Avionics Laboratory, *Dayton, Ohio* 45433 (DF099190)

To provide a microwave and millimeter device and circuit testing capability to allow rapid and accurate parameter definition and device evaluation. To make these measurements in a sufficiently accurate, precise, and repeatable manner so valid technical evaluation is possible. To test these items in a manner compatible with the most advanced industrial research evaluation procedures so that a meaningful technical dialogue is possible. To make the appropriate measurement as rapidly as possible to minimize test equipment or item under test parameter drift and to provide design feedback in a useful period.

To tailor and modify the hardware and software of an automated Hewlett-Packard network analyzer system for optimum AFAL utilization. This includes all manners of reflection and transmission parameter, particularly s-parameter, determination up to 40 gHz, with growth potential into higher millimeter frequencies. Entire testing sequences can be programmed so that the test run error due to standard drift is held to a minimum. Interactive and design feedback software will be implemented so that the true effect of design changes can be assessed. Particular accuracy and precision estimates depend upon frequency, speed and type of measurement, but in all cases meet or exceed general industrial design lab standards.

ADDENDA: Supporting agency address is: AF Avionics Laboratory DHM, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0049, PERFORMANCE INVESTIGATIONS OF ADVANCED FLIGHT VEHICLES

B.R. BENSON, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF138530)

Mission requirements can impose performance levels difficult or impossible to achieve within today's technology. New concepts or approaches are constantly being evaluated and analyzed to assess their payoff not only in performance enhancement but in the impact on cost. The objective of this effort is to investigate new concepts and technologies to assess the overall payoff for future vehicle application.

This will be an analytical performance analysis consisting of several elements. The first element will explore the aerodynamic potential in missile design. The relation between performance parameters and aerodynamic characteristics for missiles will be developed and the importance of the aerodynamic factor established. The second element will be to establish the rationale for supersonic cruise capability in a fighter and the third element will be exploration of future missile concepts.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FXGA, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0050, STUDY OF MULTIPLEX SIMULATION
J.E. CAMP, U.S. Air Force, Avionics Laboratory, *Dayton, Ohio* 45433 (DF093920)

To provide the AF with in-house capability to analyze, test, and verify feasibility of all phases of multiplex and data transfer technology. This will include, but shall not be limited to, the following efforts: (a) study of requirements of multiplexed data transfer systems, (b) study of requirements of multiplexed data transfer simulation techniques, (c) study of multiplex characteristics, (d) study of digital, analog, and software simulation techniques, (e) study of business control techniques.

In addition to the contractual effort (WU 20030701) an in-house evaluation will be made of all related and relevant material. Previously developed simulation programs, such as SIAPP, will be integrated in the contractually developed multiplex simulation through this work unit.

ADDENDA: Supporting agency address is: AF Avionics Laboratory AAF, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0051, AVIONICS LIFE-CYCLE COST
L. DARLINGTON, U.S. Air Force, Avionics Laboratory, *Dayton, Ohio* 45433 (DF098130)

Obtain and develop costing methods, models and data base for evaluating and predicting avionics development, acquisition and logistics support cost elements. Apply methods, models and data base to life-cycle cost analyses in support of AFAL programs. The capability to evaluate and predict avionics cost-of-ownership will provide for the integration of cost factors in the design tradeoff process, thereby leading to a proper and acceptable balance between avionics performance and cost.

The approach to be taken in pursuit of stated objectives includes the following activities: (1) develop data base for logistics support cost experienced by present systems utilizing AFLCS IROS (K-051) data files, (2) develop data base for acquisition of present systems, (3) develop data base establishing non-recurring (R & D) portion of program unit cost of acquisition, (4) develop predictive cost models or estimating relationships (ERS) for system development, acquisition and logistic support using historical data relating performance, production and reliability trends and associated cost.

ADDENDA: Supporting agency address is: AF Avionics Laboratory AAA, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0052, REAL-TIME ELECTROOPTICAL SENSOR PERFORMANCE PREDICTION
H.E. GELTMACHER, U.S. Air Force, Avionics Laboratory, *Dayton, Ohio* 45433 (DF101480)

To further develop and refine e-o sensor performance models developed under 69DF ADP, specifically: (1) refine models to accurately predict lab measured parameters such as video SNR vs. target status, (2) refine lab measurement techniques and instrumentation to accurately measure sensor model input/output parameters, (3) refine and develop models to accurately predict observed human plus sensor performance in lab vs. target status, (4) include most valid and accurate atmospheric models available to compute and predict effects of angular dependent scattering, absorption, turbulence, and discrete conditions such as atmospheric layers, (5) demonstrate ability to predict observed performance in real world (tower tests), (6) demonstrate ability to predict observed performance in real tactical situations w/typical tactical targets under a wide variety of weather and climatic conditions (flight tests).

The program will be performed by AFAL/RWI using in-house specialists. (1) Models developed under 69DF will be programmed to run on an in-house computer and refined to include latest available technology. Results will be compared w/lab measurements using Westinghouse active LLLTV system and AAD-7 FLIR. (2) Model parameters will dictate required measurements. Necessary new instrumentation will be purchased or developed on contract. (3) Parameter coefficients including effects of human (eye MTF, brightness, magnification) will be determined empirically by curve fitting observed performance data obtained in the lab. (4) Support from AFCRL and AFAL STAFFMET/WE will provide the best available model as a basis for experimental verification and further development to include atmospheric effects. (5) AFAL tower facility and trebein targets will be utilized for outdoor testing and development. (6) WPAFB, Eglin, PAX RWER, and other sites will be used for flight-test verification.

ADDENDA: Supporting agency address is: AF Avionics Laboratory RWI, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0053, COMPUTATIONAL FLUID DYNAMICS
W.L. HANKEY, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF136270)

A deficiency exists in the ability to compute 3-d flow fields. The objective of this investigation is to develop three-dimensional numerical methods applicable throughout the flight corridor to solve the set of partial differential equations for fluid mechanics. The current design technique for developing a new USAF system requires approximately 20,000 wind-tunnel test hours, $50 million, and takes 4 years to accomplish. Use of numerical methods in the various phases of design can dramatically shorten this cycle.

In the past decade remarkable advances have occurred in the numerical computation of fluid flows. Advances in both computation methods and computer hardware have made this progress possible. The approach will be to develop numerical codes to efficiently solve various forms of the Navier-Stokes equations on the advanced computers.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FXME, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0054, APPLICATION OF PHOTOMECHANICS TO EXPERIMENTAL STRUCTURAL ANALYSIS
G.E. MADDUX, U.S. Air Force, Flight Dynamics Lab., *Dayton, Ohio* 45433 (DF134460)

Accurate stress analysis methods are required to accomplish low- cost design, development and maintenance of aerospace vehicles. These are used to secure structural integrity for safety and longevity of a system. The objective of this effort is twofold. The first is to apply laser/optical experimental stress analysis technology such as holographic interferometry and speckle photography to current design problems. The second is to improve and/or develop new laser/optical techniques with particular emphasis on reducing the cost of design analysis. The expected payoff is an improvement of in-house capability to advance the state-of-the-art and to provide accurate and reliable analysis with a near-term impact on systems such as RPV, AFTI, AMST, ASALM, and B-1.

Under a completed exploratory development program (JON 14670212), specialized holographic and speckle photographic methods have been developed and exploited to experimentally validate finite-element stress analysis of structural components. This included strain field measurements around interference fit fasteners installed in fatigue- resistant structural joints. The current effort will involve application of this technology to composite, bonded, and weld-bonded structures. Experimental studies concerning structural joints and the stress distribution in the vicinity of fasteners will continue. Techniques for using speckle photography on high-temperature structures will be investigated. New techniques which might improve accuracy or reduce analysis cost will be evaluated. A quick response in-house capability will be maintained to solve urgent problems that often arise but are easily disposed of using the unique techniques of photomechanics.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FBEC, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0055, BOUNDARY LAYER STABILITY RESEARCH
L.I. BOEHMAN, Univ. of Dayton, Res. Inst., *Dayton, Ohio* 45409 (DF131290; F33615-74-C-3067)

The location and control of boundary layer transition can have a significant effect on the performance of flight vehicles, especially those encompassing the hypersonic cruise regime. The intent of this study is to verify analytically the effect of wall cooling on boundary layer stability found experimentally at the AFFDL. If verified then the benefit to hypersonic cruise vehicles could be significant either in terms of increased performance or reduced operational costs.

New formulations of the boundary layer stability equations where unit Reynolds number appears as a true parameter are to be solved using numerical methods. The effects of wall cooling are to be examined for possible infinite stability levels when a given spectrum of disturbances are used as an input. Parasitic error growth during the computer work could pose a technical problem.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FXE, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0056, EXPERIMENTAL RESEARCH ON FLUID DYNAMIC ENERGY CONVERSION AND TRANSFER PROCESSED
R. GRIFFITH, Univ. Energy Systems Inc., *Medway, Ohio* 45341 (DF214030; F33615-73-C-4053)

AF function - aerospace propulsion, electromagnetic weapons. Deficiency - efficient large capacity, low-pressure vacuum pumping, high-pressure recovery compact internal fluid dynamic supersonic diffusers. Research - turbulent mixing, multicomponent flow processes, supersonic diffusers. How research contributes - provides new knowledge relevant to improving energy conversion and transfer concepts for advanced propulsion and electromagnetic weapons systems. Multicomponent flow studies are directed at the demonstration of a capability to develop a useful low-pressure vacuum pump using multicomponent processes. Energy transfer studies are directed at enhancing the mixing of multiple streams through unconventional turbulent means. Laser diffuser studies are directed at providing compact, lightweight supersonic diffusers for gas dynamic and radial outflow chemical lasers.

Primarily through experimental means, provide data extending the state-of-the-art in multicomponent flows and fluid dynamic energy transfer. Specifically, provides data on the (1) processes involved in the use of multicomponent flow for high volume, low-pressure vacuum pumping, (2) use of novel concepts for internal fluid dynamic supersonic diffusers, (3) application of fluidically controlled self-oscillating nozzle flows for enhanced mixing.

ADDENDA: Supporting agency address is: Aerospace Research Laboratory LE, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0057, TURBULENT WAKE RADAR CROSS SECTION
P.E. BISBING, General Electric Company, *Philadelphia, Pennsylvania* 19101 (DF900840; F19628-76-C-0011)

AF function - advanced missiles and decoys. Deficiencies - inability to accurately predict the radar cross section of the turbulent wakes and plumes of reentry vehicles and decoys. How research contributes - recent flights of the SRAM (short-range attack missile) revealed some serious discrepancies between the predicted and observed radar cross section of the wake. It is the purpose of this program to develop an improved computer code which can remedy this deficiency. The code can be used as an aid in the design of decoys with wake properties which simulate those of a warhead.

ADDENDA: Supporting agency address is: Rome Air Development Center ETE, Griffiss AFB, NY 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0058, TRANSONIC FLOW AT A SLOTTED TEST SECTION WALL
G. DROUGGE, Aeronautical Res. Inst., *Bromma, Sweden* (DF033640; AF-AFOSR-2184-72)

Weapons delivery, air superiority and logistic support all require the AF to operate and maneuver at transonic speeds. With the trend towards higher performance transonic vehicles engineering design will have to be reduced to a more rigorous science than is now possible with the present state of knowledge on laboratory simulation of transonic flow. Of prime interest for the future will be the ability of the scientist and engineer to obtain transonic wind-tunnel data of unprecedented accuracy, thereby minimizing the costly consequences of small errors in interpreting and scaling model results to full-scale flight conditions. One of the parameters of concern in the evaluation of transonic wind-tunnel data is tunnel wall interference. The wall interference is alleviated by ventilation of the tunnel walls. There are strong indications that this ventilation produces interference effects, particularly with large models at high angles of attack, which cannot be satisfactorily eliminated by commonly used wall corrections. The present research is concerned with the flow through slots in the wind-tunnel wall and, in particular, with the role of the wall boundary layer in establishing this flow and in communicating the effect of the presence of the slot to the flow in the test section.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0059, USE OF HARMONIC ANALYSIS IN ESTIMATION AND CONTROL THEORY
S.I. MARCUS, Univ. of Texas, School of Engineering, *Austin, Texas* 78712

DESCRIPTION: The purpose of this research project is the development and evaluation of techniques, based on the theory of harmonic analysis, for design of high-quality, easily implemented optimal and suboptimal estimation and control systems for certain classes of nonlinear systems. The nonlinear systems considered have the structural property that they evolve on compact Lie groups or homogeneous spaces.

Techniques have been developed for the use of harmonic analysis in the design of filters for phase tracking and demodulation, satellite tracking, and rigid body orientation estimation. The performance of these filters is being evaluated by means of computer simulations. In addition, these techniques are being extended to problems of deterministic and stochastic control.

SUPPORTED BY University of Texas

4.0060, NAVY VEHICLE DESIGN AND CONSTRUCTION - OPTICAL DATA TRANSFER FOR SHIPS AND AIRCRAFT
K.L. LAWLEY, Texas Instruments Incorporated, *Dallas, Texas* 75222 (DN323042; N00014-73-C-0288)

Research is being directed toward development of a room-temperature, pulsed, double heterostructure (dh), monolithic, GaAlAs- GaAs injection mesa laser and to the coupling of the output of the dh laser to a planar GaAlAs waveguide. The ultimate goal is fabrication of a monolithic room-temperature optical transmitter.

A TI developed selective liquid-phase epitaxy technique for the growth of monolithic lasers is being employed to grow double-heterostructure, low-threshold GaAs-(Ga, Al) as injection mesa lasers. Each laser will be coupled evanescently to a planar (Ga, Al) As waveguide lying beneath the mesa. Design goals are: 1W peak laser power outut; 250mW peak power coupled into the waveguide; 200nsec pulse width; 1kHz repitition rate; and 5kw/cm2 threshold current density.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, Va 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

4.0061, LASING AND COMBUSTION STUDIES OF FAST-FLOW SYSTEMS
R.A. COOKSON, Cranfield Inst. of Technology, *Bedford, England, United Kingdom* (DF038990; AF-AFOSR-2698-74)

AF function - advanced air-breathing engines and high-power chemical lasers, weapon delivery and defense. Deficiency - insufficient understanding of the basic mechanisms and processes associated with coherent radiation produced from reaction

products of hydrogen or hydrocarbon/air and gas dynamic/combustion aspects of fast flow reacting systems, lack of realistic guidelines for predicting properties and feasibility of electronic transition lasers produced from hydrogen and/or hydrocarbon fueled systems and of supersonic combustion systems. Objectives - to understand and develop theoretical and mathematical models realistically describing the mechanisms and processes associated with lasing and supersonic combustion phenomena in hydrogen and hydrocarbon fuel-air mixtures. How work contributes - will provide additional understanding of the chemical lasing and supersonic combustion phenomena not now available and will contribute to the technology base required for realistic evaluation of the potential and development of improved high-power chemical laser and combustor devices based on fast-flow combustion.

Investigation will be made of the feasibility of constructing and operating a lasing system in the 4 eV energy range using a high-enthalpy combustion facility. Emphasis will be placed on hydrogen or hydrocarbon fuels reacting in the slow speed or supersonic flame modes to produce an electronic transition OH chemical laser. Mechanisms for the excited- state OH formation will be investigated. Measurements will be made of the OH concentrations, OH self-absorption, absorption by combustion products, excitation and depopulation rates, etc., and the data used to determine whether gain exists in any of the vibro-rotational lines and the OH lasing efficiencies. Similarly, an extensive spectroscopic study in hydrocarbon fueled systems will be made to determine rate constants for CH and C2 radicals. Also, studies will be made of the IR emission within the ground and first electronic excited states of OH, CH and C2 radicals, produced via combustion of hydrogen and hydrocarbons, to discover what gain/loss exists. In addition, study will be made of chemical reaction phenomena in supersonic air streams, including the effect of combustor geometry, ignition, fuel injection modes, on enclosed supersonic diffusion flames. Complementary theoretical analyses will interpret the experimental data. (Text Abridged.)

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0062, TURBULENCE AND SHEAR LAYERS IN HIGH-ENERGY LASERS

D.A. RUSSELL, Univ. of Washington, School of Engineering, *Seattle, Washington* 98105 (DF036570; AF-AFOSR-2512-73)

AF function - weaponry, aerospace vehicles. Deficiency - high- energy lasers encounter a number of difficult problems in high-speed gas flow. Among these are nozzle flows, mixing layers and wakes with and without chemical reaction, and shock wave patterns downstream of multiple nozzles. All of these flow features, as well as many others, affect laser performance in terms of power output, gas consumption, beam quality and coherence. More detailed understanding of these phenomena is needed in order to optimize designs of gas flow lasers. Objective - to investigate nozzle flows, mixing regions, shear layers, and wave patterns downstream of multiple supersonic nozzles, and to relate these phenomena to laser performance. How work contributes - detailed quantitative understanding of the fluid flow features in lasers will make possible the rational use of design trade-off methods to optimize practical high-power gas flow lasers.

A combined experimental and analytical program is being conducted. The current extension of the work will include development of instrumentation for measuring local instantaneous species concentration in reacting mixing layers, experimental study of the flow downstream of an array of mixing nozzles, further refinements and simplifications of the present wave calculation procedures.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

GEOSCIENCES

Includes Geosciences (general); Earth Resources; Energy Production and Conversion; Environment Pollution; Geophysics; Meteorology and Climatology; and Oceanography. For Related Information See Also Space Sciences.

5.0001, A NEAR-INFRARED PHOTOGRAPHIC SKY SURVEY

E.R. CRAINE, Univ. of Arizona, Steward Observatory, *Tucson, Arizona* 85721

OBJECTIVE: To photograph the entire northern sky at near-infrared wavelengths (.8-.9 micron) to a limiting magnitude of 18I with a resolution of 2 to 3 inches. This survey will serve primarily as an identification and discovery tool for very red objects as well as a variety of objects obscured by hydrogen emission and dust.

APPROACH: Photography will be carried out using a 140 mm S-20 (red extended) image tube camera at the Newtonian focus of a wide, flat field telescope of 20 inches aperture located at the Steward Observatory Kitt Peak station.

PROGRESS TO DATE: The telescope/camera system is nearing completion with on-site installation to occur in June 1976. Observing programs and publication format schemes are nearing finalization.

PROJECTED SCHEDULE: Survey photography will begin during the summer of 1976 and is expected to continue for 2 to 2 and a half years. Preliminary data analysis for several classes of objects will be carried out as the photography progresses. One type of atlas format will be produced as the photography program is underway and about 100 sets of survey atlases should be available immediately upon completion of survey photography.

SUPPORTED BY Natl. Geographic Soc. - Washington, D.C.

5.0002, AERIAL PHOTO SPECIFICATIONS FOR FORESTRY

R.N. COLWELL, Univ. of California, Agric. Experiment Station, *Berkeley, California* 94720 (0010844; CA-F0-FRU-1329)

OBJECTIVE: Determine, for forested areas, the type of aerial photography from which information essential in the practice of forestry can be most accurately and readily extracted.

APPROACH: The work will be designed so as to permit a determination of the relative ease and accuracy with which forest composition, vigor, density, size, age structure, and land features can be recognized on photography taken with various film-filter combinations, at various scales, and at various times of the day and year. Spectrophotometric analyses of the objects and conditions to be identified will first be made, in order to select the film-filter combinations which theoretically will provide the best photographic tone or color contrasts. Aerial photography of representative forest areas will then be flown with the selected film-filter scale combinations at various times of day and year. Through photo interpretation, estimates will be made from each set of photos as to forest conditions existing within the test areas. The accuracy of the interpretations will be determined by field checking, so that the specifications for optimum forest photography can be formulated.

PROGRESS: On January 23, 1975, LANDSAT 2 was successfully launched, first to augment and eventually to replace LANDSAT 1 (previously called ERTS-1) as the spacecraft from which imagery of various NASA test sites (including our NASA Bucks Lake Forestry Test Site in the Sierra) would be acquired. Our tests show that (1) imagery from LANDSAT 2 is slightly superior, in terms of spatial resolution, to imagery of LANDSAT 1; (2) the ability to obtain LANDSAT overflights of our Bucks Lake Test Site every 9 days instead of every 18, as when only LANDSAT 1 was operative, is of great benefit, particularly in ensuring cloud-free coverage at suitably frequent intervals. Such imagery is highly useful for monitoring snow accumulation and depletion in our test site, as well as the filling and draw-down of reservoirs and the monitoring of soil moisture changes and evapotranspiration rates. Our success in estimating timber volumes with the aid of LANDSAT imagery and of determining timber stand conditions classes has led to increased cooperation with U.S. Forest Service personnel on the Plumas National Forest. (Text Abridged.)

SUPPORTED BY California State Government - Sacramento

5.0003, INVERSION THEORY RESEARCH

W. KAULA, Univ. of California, School of Letters & Science, *Los Angeles, California* 90024 (DF243250; F19628-75-C-0007)

AF function - weapons systems navigation and delivery. Deficiency - geoid uncertainties degrade accuracy of weapons delivery. Objective - use of inversion theory to determine ter-

restrial gravity field. How research contributes - will provide a firm basis for evaluating the gravity field from satellite data.

The contractor will rigorously explore the accuracy potential of inversion theory as it pertains to the determination of the terrestrial gravity field.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LW L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0004, EPHEMERIDES SYSTEMS APPLICATIONS
K. BHAVNANI, Logicon Incorporated, *Torrance, California* 90503 (DF246470; F19628-75-C-0039)

AF function - ephemerides systems applications for research on physics of upper atmosphere. Deficiency - requirement for continual modification and maintenance at state-of-the-art level, for current vehicles of interest and any future launches. Objective - advancement and improvement in orbital parameter accuracies as required by researchers investigating experimental results. How research contributes - determination of atmospheric effects, e.g., density of atmosphere, atmospheric drag on a vehicle, geomagnetic effects during periods of high, medium and low solar activity, as well as improvements in earth modelling and continuing investigations of auroral zone data.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory SU L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0005, RELATION OF INFRARED DOPPLER LIDAR TO REMOTE WIND MEASUREMENTS IN THE TURBULENT ATMOSPHERE 13470-GS
R.L. SCHWIESOW, U.S. Dept. of Commerce, Natl. Oceanic & Atmos. Admin., *Boulder, Colorado* 80302 (DA0Z5575)

Develop basic information on the effects of the atmosphere on coherent (homodyne) infrared Doppler lidar, and from the atmospheric limitations predict system potential for remote wind measurement. The Army needs a capability for real-time, high-resolution spatial and temporal wind measurements to be used in the correction of artillery fire, to increase safety and efficiency of aircraft landing and takeoff from remote airfields, and to predict transport and diffusion of gasses and particulates (pollutants) in the atmosphere. The research also has application to detection of chemical agents in the atmosphere.

Experiments will be conducted in the atmosphere using an existing infrared Doppler prototype instrument at an optical test range at NOAA Table Mountain field site. The signal level and effective telescope diameter for coherent optical processing will be determined for various meteorological conditions. Based on these results, an analysis will be made of the feasibility of a remote differential Doppler configuration for measurement of velocity components perpendicular to the bisector of the intersecting incident beam.

ADDENDA: Supporting agency address is: DARCOM Army Research Office Box 12211, Research Triangle Park, NC 27709

SUPPORTED BY U.S. Dept. of Defense - Army

5.0006, ENVIRONMENTAL REMOTE SENSING
V. NOBLE, U.S. Navy, Res. Laboratory, *Washington, District of Columbia* 20375 (DN220082)

To determine experimentally the necessary sensors and techniques which are applicable from spacecraft for improving oceanographic monitoring and prediction, and to establish within NRL a focal point for coordinating remote sensing studies with the objective of satisfying Navy Environmental Remote Sensing Program (NERSP) needs.

Utilize electromagnetic sensors, both passive and active, to determine quantitatively the accuracies with which sea surface temperature, surface winds, wave heights, topography and other sea surface parameters can be measured. From this information analytically extend the measurements to satellite sensors to determine their performance. In the course of these studies it is necessary to insure that the measurements and techniques are fulfilling NERSP's needs.

ADDENDA: Supporting agency address is: Naval Air Systems Command (AIR 370C1), Washington, DC 20361

SUPPORTED BY U.S. Dept. of Defense - Navy

5.0007, HIGH-ALTITUDE ATMOSPHERIC INVESTIGATIONS
H.U. WIDDEL, Max Planck Inst. For Aeronomy, *Lindau, Federal Republic of Germany* 3411 (DA0C9409; DAERO 75 G0076)

To investigate properties & behavior of lower thermosphere, mesophere & d-region, of the ionosphere.

Develop suitable techniques, both in situ and ground based, for measuring & studying these properties & characteristics. Rocket-borne sensors and other instrumentation will be utilized. Joint efforts between Max Planck Institute-Lindau and ASL-White Sands are basic to program. This project is relevant to ASL research program & contributes to communications, missile and artillery problems and many other Army field problems.

ADDENDA: Supporting agency address is: DARCOM Research & Standardization Group (Europe), Box 15 FPO NY 09510. Performing organization: Max-Planck Institut fur Aeronomie.

SUPPORTED BY U.S. Dept. of Defense - Army

5.0008, DOPPLER CLOUD OBSERVATIONS
R.M. LHERMITTE, Univ. of Miami, School of Marine & Atm. Sci., *Miami, Florida* 33124 (DN223333; N00014-75-C-0321)

The objective of this renewal is to use the dual Doppler radar system of the University of Miami in the Florida Area Cumulus Experiment (FACE) in conjunction with a similar radar from NOAA for the purpose of determining the internal circulation of a cumulus cloud during the precipitation stage. Safety of flight and improvement of the naval weather forecast constitute naval relevance.

The two Doppler radars of the University of Miami will be moved to Kae Okeechobee where they will be set up along with the NOAA Doppler radar for the purpose of determining the field of motion of the hydrometeors within the cloud and also the reflectivity of the precipitation elements. One other radar from the New Mexico Institute of Mining and Technology NR 082-167 will also be involved in FACE.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, Va 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

5.0009, RADIO PROPAGATION IN DISTURBED IONOSPHERES
J. BUCHAU, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF244700)

AF function - communications via and through arctic and other disturbed ionospheres and OTH radar. Deficiency - imcomplete understanding of disturbed ionosphere and its effects on communications, navigation and OTH radar. Research - arctic propagation experiments conducted by Airborne Ionospheric Laboratory and the Goose Bay Ionospheric Observatory (GO). Study effects of the ionosphere on radiowave propagation in terms of auroral absorption, mode availability, Doppler spread. Development of GIO real-time ionospheric specification; improved understanding of gradients, irregularities and rapidly varying and disturbed ionospheric conditions on EM propagation. How research contributes - aids the development of OTH radar systems such as 4141 4401, survivable communications systems, and satellite systems such as AFSATCOM, GPS and DSCS in terms of improved design, and operations. Improvements are in the areas of bandwidth, power requirements, frequency management, antenna design, system accuracy and reliability assessment and operational employment procedures.

This work unit makes use of the Airborne Ionospheric Laboratory and the Goose Bay Ionospheric Observatory to study the effects of the strong ionospheric gradients occuring at high latitudes and the associated auroral activity on hf propagation, especially with OTH problems in mind. Propagation flights in the 4141 coverage area will be made starting in January 1976 in conjunction with new antennas at Goose Bay and RADC to study specific aspects of the 4141 situation. These tests will allow further evaluation of the ionospheric model to be used during the 4141 test phase. A report on past oblique hf propagation experiments

will be completed by January 1976. The aircraft will be equipped to play a vital role in the 414l performance tests. Airborne UHF scintillation studies will be continued in connection with AFSATCOM I and II in the arctic and equatorial anomaly regions.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LI, L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0010, VEHICLE CHARGING AND BREMSSTRAHLUNG
H.A. COHEN, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF247330)

AF function - communication satellites in geosynchronous orbit. Deficiency - electrical charging of satellites by ambient particles causing anomalous switching of electronic circuitry. Research - development, testing and use of charge ejection systems to duplicate, prevent, or control satellite charging. How research contributes - by the development, testing and use on space vehicles of charge ejection systems, charging of satellite surfaces can be controlled for predetermined periods, obtaining either large or small potential differences with respect to ambient plasma.

Systems for the controlled ejection of charge from space vehicles, and specifically the Scatha satellite, will be designed, fabricated, tested and flown. A sounding rocket payload will be built and flown to obtain information on the functional relationship between charge ejection from a space vehicle, ambient parameters, and the resultant space vehicle - plasma potential difference. For the Scatha satellite a satellite electron beam system (SEBS) and a satellite positive-ion beam system (SPIBS), will be developed, built and tested.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LK, L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0011, REFERENCE ATMOSPHERES
A.E. COLE, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF244060)

Air Force function - design and operation of aerospace vehicles. Deficiency - distribution, as well as time and space variations, of the thermodynamic properties of the atmosphere for levels up to 100 km must be known in order to establish design criteria and operational procedures for various types of reentry vehicles. Objective - develop mathematical models of the atmosphere which portray latitudinal, longitudinal, monthly, and day-to-day variability of pressure, density and temperature at levels up to 100 km. How research contributes - a more detailed knowledge of atmospheric structure below 100 km will be useful in targeting and in design of systems for intercepting ballistic missiles.

Analyze and evaluate all observations of the thermodynamic properties of the atmosphere between 30 and 100km to insure a uniform data sample. Eliminate data that are biased or in error due to faulty sensors. Develop mathematical models of the thermodynamic properties of the atmosphere between the surface and 100km which provide a complete description of the monthly, latitudinal and longitudinal variations in atmospheric structure. Include models which depict conditions during 'sudden warmings' of the stratosphere and mesosphere in arctic and sub- arctic regions during the winter months. These models will replace the U.S. Standard Atmosphere Supplements, 1966, which are used by all aerospace engineers and designers in the United States as design criteria. The new models will present a more complete description of the variation in atmospheric structure for levels up to 100km and will be called U.S. Reference Atmospheres.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LK, L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0012, VERTICAL ATMOSPHERIC OPTICAL PROBING
L. ELTERMAN, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF244290)

AF function - target acquisition and tracking, reconnaissance. Deficiency - the design engineer for electrooptical systems needs atmospheric models for light attenuation which he can use to determine boundary conditions for optimal and minimal performance of reconnaissance or other military systems. Research - balloon and remote ground measurements of vertical profiles of aerosol properties and correlation of the results with theoretical concepts to derive atmospheric models for light transmission. How research contributes - provides representative aerosol model atmospheres for 'good' and 'bad' seeing conditions, which can be employed to predict and evaluate the restrictions of the natural atmosphere on the performance of optical military systems and the dependence of the restrictions on altitude, wavelength, and systems geometry.

To measure profiles of aerosol properties of the lower and upper atmosphere up to 35 km and determine the vertical variation and structure of the optical parameters. This is done by searchlight backscattering measurements and in-situ balloon measurements. Results are transformed into model atmospheres for light transmission computations for any optical path through the atmosphere and, therefore, are applicable to a wide variety of military operational problems.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory OP, L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0013, STRATOSPHERIC DYNAMICS
R.E. GOOD, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF244810)

AF function - environmental impact statements of high-altitude Air Force operations. Deficiency - current or anticipated Air Force operations in the stratosphere may deposit harmful material and it is important to be able to assess the dispersion and residence time of such material in the stratosphere. Research - the necessary high-resolution techniques for measuring turbulent transport and lifetime will be developed and tested on balloon platforms. Models of aircraft and missile wake dispersion will be developed. How research contributes - models will be developed from the experimental observation to predict the dispersion, spreading and lifetime of aircraft and missile exhaust products in the stratosphere.

In order to obtain experimental data on possible turbulence, three main techniques are employed: (a) chemical smoke trails formed vertically by rockets which give the vertical profiles of horizontal winds, (b) balloon-borne sensors giving temperature and microscale vertical wind components (and, in general, 3-d winds) and (c) aircraft wake studies. The resulting data (consisting for the most part of time- lapse photographs from several locations simultaneously) are triangulated and measured (assisted by several computerized data- reduction techniques) and these data are further reduced to give wind shears, Richardson numbers (criteria for turbulence instability) and energy spectra (giving turbulence information). The resulting estimates of the vertical turbulent transport effects will be fed into dynamic models in order to learn the expected impact from vehicle emissions.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LK, L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0014, AURORAL OVAL AND IONOSPHERIC SUBSTORM MONITORING
W. HALL, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF244710)

AF function - ionospheric monitoring for frequency for communications, radar and navigation systems. Deficiency - unpredictability of polar ionosphere and accurate and timely frequency management data are lacking. Research - improved monitoring of the high- latitude ionosphere in terms of the auroral oval and magnetic substorms. An integral part of this research is the search for ionospheric, photometric and photographic observables which can characterize large phenomena in the d, e and f region, and hence show promise of being used to monitor the state of the arctic ionosphere. How research contributes -will aid AWS Environmental Support System (SESS) and Global Weather Central in real- or near-real-time ionospheric monitoring to improve frequency management of navigation, communication, tracking

and OTH radar systems. System accuracy, reliability and operational procedures will also be enhanced. Long-range contribution will be to a completely operational network to enable highly reliable routine operations of these AF systems.

Continue the investigation, how through environmental sensors at high latitudes the arctic ionosphere can best be monitored. The development of an automatic data compression system will lead to a data stream compatible with either telephone or satellite link with display capabilities at user sites. The techniques to interpret these data in terms of ionospheric and auroral activity will be developed at an AFCRL terminal and will be transferred to Global Weather Central. To enhance data quality of vital Goose Bay backscatter data, antenna modification is required and will be completed at latest by May 76. A study of auroral oval monitoring and use of high FOES, enhanced FMIN and location of backscatter as auroral substorm indicators will be completed by December 1975.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LI, L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0015, UPPER-AIR MEAN WINDS FOR REENTRY VEHICLES

AJ. KANTOR, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF244050)

Air Force function - design and operation of reentry bodies and other aerospace vehicles. Deficiency - need for climatological wind information for wind-affected missile and aircraft systems, particularly in the event of unavailability of real-time wind forecasts. Objective - compare actual observed upper-air winds with theoretically deduced winds which are presently used to provide wind velocities for aerospace vehicle and operations. How research contributes - improved climatological wind data will be an important factor in the design of various reentry vehicles as well as in operational use of wind-affected systems when real-time data and forecasts are unavailable.

Up to eight years of mean monthly winds, based on actual observed velocities at more than 500 locations, are being examined for nine standard pressure altitudes between 5,000 feet (850 mb) and 78,000 feet (30 mb). The mean monthly velocities observed at each station and level will be related to the deduced mean monthly winds to determine the limitations and inaccuracies of the deduced values. North-south and east-west components will be machine analyzed and compared to determine differences at these levels over the Northern Hemisphere, tropical regions and, if feasible, over the Southern Hemisphere.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LK, L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0016, UPPER-ATMOSPHERE PROPERTIES

T.J. KENESHEA, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF244580)

AF function - communications and satellite surveillance. Deficiency - inadequate knowledge of the atmosphere, particularly for determining the effects of natural or man-made disturbances. Objective - to measure turbulent and laminar transport coefficients in the upper atmosphere and develop improved theoretical model atmospheres of neutral and ionic composition. How research contributes - following solar proton events and nuclear detonations, radio communications are interrupted and missiles and satellites are lost from radar view. Improved models which can predict ionospheric perturbation effects can aid in the communications with and tracking of airborne vehicles and missiles during these events.

Computer codes have been expanded to include nitrogen and ionic species as well as dynamic mechanisms and will be used to generate theoretical atmospheric models. These models will be extended to include heat, momentum and energy transfer as well as solar and dynamic heat sources. Meridional circulation will also be incorporated into these models, based upon the latitudinal differential spatial heating due to the solar and dynamic mechanisms operative in the atmosphere.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LK, L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0017, RADIANCE INVERSION TECHNIQUES FOR ATMOSPHERIC INFERENCING

J.F. KING, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF246150)

AF function - optical environmental sensing. Deficiency - inability to extract atmospheric structure needed for flight operations from DMSP satellite observations. Objective - develop an optimal inversion technique for inferring vertical atmospheric temperature from remotely sensed DMSP infrared radiance data. How research contributes - information inherent in DMSP vertical profiler is currently unexploited because of unsatisfactory data-processing (inversion) techniques. Optimal inversion method would extract all possible atmospheric structural information for flight operations and surveillance systems.

A new nonlinear inversion method has been developed which employs repeated convolution rather than direct inversion to fit the satellite observations. Technique is compatible for use with empirical atmosphere transmittance data.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory OP, L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0018, FREE BALLOON INSTRUMENTATION

H. LAPING, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF243940)

AF function - advanced balloon systems (surveillance, delivery operations, environmental research support, space equipment test). Deficiency - an economical, accurate global balloon tracking capability does not exist. Objective - develop a VOR balloon tracking capability for the continental United States and an omega balloon tracking capability suitable for worldwide use. How research contributes - positive free balloon tracking, on a worldwide basis, will be possible. The accuracy and timeliness of the position information will be such as not only to satisfy both civil and military air safety requirements, but also to provide a reliable economical method to track free balloon flights over remote or inaccessible areas.

Final test flights will be conducted to confirm accuracies attainable using the VOR free balloon tracking equipment. Two test flights of a prototype omega signal processor will be conducted over the continental United States. Data from these flights will be studied to evaluate operational problems, signal quality and comparative position accuracy with respect to VOR and radar.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LC, L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0019, MASS SPECTROMETER DEVELOPMENT FOR NWER

R.S. NARCISI, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF279480)

AF function - nuclear weapons delivery, communications, radar detection, track and intercept (B-1, AABNCP, AWACS). Deficiency - radio wave transmission and radar track capability cannot be reliably predicted, especially following nuclear detonations or solar flares. Inadequate instrumentation and measurements of lower ionosphere structure. Objective - develop and update various rocket-borne mass spectrometers as an inventory for nuclear test instrumentation. Perform atmospheric measurements to provide data for weapons-effects computer codes. How development contributes - maintains the availability of state-of-the-art instrumentation for the possible resumption of atmospheric testing. Provides atmospheric measurements during natural disturbances which simulate nuclear detonations so that computer codes can be developed which define survivable communications and perturbations on radar and optical/IR systems.

Various types of rocket-borne mass spectrometers are designed, developed and tested in the laboratory to measure the positive ion, negative ion and neutral composition over the altitude range 50-200 km. Atmospheric measurements are performed in coordinated DoD programs during atmospheric disturbances. The data are reduced and analyzed and then pro-

vided to AF/DNA for the development of weapons-effects computer codes.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LK, L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0020, SCATHA MEASUREMENTS

A.L. PAVEL, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF242890)

AF function - communications and surveillance. Deficiency - performance anomalies of synchrous satellites have been linked to environmental disturbances. Research - the development, construction and testing of satellite instrumentation to define the charged particle environment at synchronous orbit. A set of instruments will be developed to measure electron and proton fluxes from thermal levels to energies in excess of 300 keV. Particle energy spectra and bulk particle motions will be analyzed during both magnetospheric quiet and storm times. How research contributes - these particle sensors will be part of the complement of instruments aboard the Scatha satellite. Charged particles, such as are present during magnetospheric storms, have been shown to create high spacecraft potentials. The Scatha satellite is designed to provide the required information for an analysis of the effects of spacecraft charging on Air Force systems at synchronous orbit. Instruments for flight aboard the Scatha satellite will provide a maximization of information while the stringent requirements for reaching synchronous orbit demand a minimization of weight, power and telemetry.

The Energetic Particles Branch of the Space Physics Laboratory will provide electrostatic analyzers and solid-state spectrometers for the Scatha satellite. These instruments will define, on a rapid time basis, the influx of high-energy particles to a geosynchronous satellite. The Electrical Processes Branch of the Space Physics Laboratory will build plasma diagnostic instruments for the Scatha satellite. These instruments will provide data on the low-energy plasma environment at synchronous altitudes. The Atmospheric Structure Branch of the Aeronomy Laboratory will furnish an electron gun for the Scatha satellite. The electron gun will allow the spacecraft potential to be actively charged under a variety of conditions. These experiments will be coordinated with other Scatha engineering experiments to relate cause and effect in spacecraft charging.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory PH, L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0021, TROPOSPHERIC REFRACTIVE BENDING

L.E. TELFORD, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF244940)

AF function - communications, navigation. Deficiency or opportunity - present methods for correcting for tropospheric refractive bending assume a horizontally stratified atmosphere. For low elevation angles these methods usually fail since the ray traverses long horizontal distances and the assumption of horizontal stratification is not valid. Objective - develop and test a tropospheric refractive-bending prediction system which uses surface refractivity plus atmospheric emission data in the millimeter wave region of the electromagnetic spectrum. How research contributes - this research will determine whether it is feasible to use atmospheric emission measurements to obtain refractive-bending corrections.

Accurate measurements of refractive bending using the sun and the moon as targets and the measurement of atmospheric emission at frequencies between 15 and 55 gHz are conducted simultaneously and the two sets of data are correlated.

ADDENDA: Supporting agency address is: AF Cambridge Research Laboratories LZ, L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0022, HIGH-RESOLUTION SPECTROSCOPIC STUDIES

G.A. VANASSE, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF255440)

AF function - surveillance, target detection, reconnaissance and communication. Deficiency - lack of detailed knowledge about the infrared radiation environment a military system will function in. Research - development of more efficient spectrometric techniques for carrying out infrared measurements of atmospheric transmission and background emission. How research contributes - permits more rapid measurement of infrared radiation from night sky emission, airglow, aurora, cool stars, atmospheric backgrounds and/or of transient phenomena at high spectral resolution. Permits ultra-high-resolution laboratory measurements of spectral line positions and strengths of atmospheric emitters and absorbers. Detailed knowledge of atmospheric transmission and background emission is required in order to optimize the design and performance of military weapon, detection and communication systems. The research will yield data which will be incorporated into the LOTRAN and HITRAN transmission codes.

A two-meter path difference Fourier-transform spectrometer will be modified and improved to optimize the performance and signal-to-noise ratio for particular regions of the infrared for ultra-high-resolution measurements on water vapor, methane and other atmospheric constituents. A hot gas cell will be modified and adapted to the two-meter instrument to allow high-resolution emission measurements of atmospheric constituents and exhaust gases at simulated jet aircraft plume temperatures.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory OP, L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0023, COORDINATED ANALYSIS OF AURORAL DATA ON THE ATS FIELD LINE

R.H. EATHER, Boston College, School of Arts & Sciences, *Chestnut Hill, Massachusetts* 02167 (DF044480; F44620-76-C-0129)

AF function - the coupling of solar activity to the interplanetary medium of the earth's magnetosphere to the earth's atmosphere is of continuing importance to the Air Force mission for the effects on communication. One aspect of this, auroral study, is particularly enigmatic and deserving of a high level of effort because of the adverse effects on operations in the polar regions. Deficiency - the method of transfer of energy in the form of corpuscular and electromagnetic radiation to the earth's upper atmosphere is unknown in detail. It is necessary to ascertain this nexus if a predictive capability is to ensue. Objective - this particular study will pursue an interpretation of data taken with various instruments along one field line of the earth's magnetic field. Ground magnetic, ground visual, satellite visual and satellite particle measurements will be combined to study the processes involved in aurora. Contribution - if a connection can be made between a measurable parameter, e.g., particle flux, magnetic field change, and subsequent transient activity in the earth's atmosphere, there may be the possibility of a predictive capability for these events arising.

This research will seek the following scientific objectives: (1) comparison of trapped fluxes by ATS 5 and 6, loss cone flux measured by ATS 6, and auroral parameters measured at the feet of the ATS field lines; (2) the answer to the question 'are plasma injection events a result of plasma transport from the tail, or of in-situ acceleration;' (3) the study of enhanced loss cone fluxes and their sources; (4) the delineation of the extent of the auroral injection region; (5) calibration of DMSP photographs in terms of the more commonly measured auroral spectral emissions.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NP Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0024, DIAGNOSIS OF GREEN VEGETATION BY REMOTE SPECTRAL MEASUREMENT

M.L. HERZ, U.S. Army, Natick Research & Dev. Command, *Natick, Massachusetts* 01760 (DA0G4363)

The in vivo spectral characteristics (i.e., reflectance, absorbance, emission) of higher plants will be measured as a function of the life cycle of the plant. The physical state of the plant, in particular, the life stage and plant condition, and these spectral properties will be evaluated to determine correlations between the spectral variations, the photosynthetic pigments, and the plant condition.

Rapid and accurate measurement of the spectral characteristics of higher plants can be made from the UV into the IR region of the spectrum using specialized equipment including the Tektronix 7J20 rapid-scan spectrometer for field and laboratory measurements of reflectance, absorbance and emission, and the Gary 17I spectrometer with reflectance attachment for laboratory measurements in several different reflectance modes to give absolute reflectance. Selected measured spectral data can then be digitized and coded. This data, the experimental conditions of its measurement, and data descriptors can be stored on magnetic tape for retrieval purposes. Upon retrieval, arithmetic manipulation of the spectral data (i.e., axis modification, integration, peak printout, ratio spectra, derivative spectra, difference spectra) becomes possible to allow determination of actual changes with increased sensitivity.

ADDENDA: Supporting agency address is: NARADCOM Army Natick Research & Dev Command, ATTN- DRXNM-VM, Natick, MA 01760

SUPPORTED BY U.S. Dept. of Defense - Army

5.0025, STRATOSPHERIC WATER VAPOR
P. GOODMAN, Panametrics Incorporated, *Waltham, Massachusetts* 02154 (DN223332; N00014-75-C-1114)

The objective of this research is to obtain flight data (balloon and aircraft) on an improved water vapor sensor to be used in the Climatic Impact Assessment Program (CIAP).

The sensor will be used in radiosonde balloons in a modified radiosonde for atmospheric profiles of water vapor. It will also be mounted in an RB 57 to obtain estimates of water vapor change over large horizontal distances.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

5.0026, SATELLITE DATA PROCESSING AND ANALYSIS
R.W. FIORETTI, R D P Incorporated, *Waltham, Massachusetts* (DF247630; F19628-76-C-0244)

AF function - airborne surveillance, target acquisition. Deficiency - atmospheric density variations with time and space cannot be accurately predicted. Research - direct density measurements with satellite-borne accelerometers. Results are correlated with solar- geophysical parameters and other experiments. How research contributes - permits accurate determination of Air Force satellite ephemerides.

A SETA accelerometer is to be flown on Air Force satellites. This instrument permits high-accuracy, high-resolution atmospheric density measurements. Telemetry data from all the experiments will be provided on tape. The raw SETA data will consist mainly of drag accelerations which are proportional to density and accelerations due to vehicle motions caused by thrusting. Digital filtering methods are used to determine those accelerations due to drag. Density is calculated directly from the drag data. These results are used to accurately determine the orbit of the satellite. In addition the density results are used in developing accurate atmospheric models.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LK, L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0027, SATELLITE DENSITY ACCELEROMETER
W. LANGE, Bell Aerospace Company, *Buffalo, New York* 14240 (DF242380; F19628-74-C-0114)

AF function - airborne surveillance, target acquisition. Deficiency - atmospheric density variations with time and space cannot be accurately predicted. Research - direct density measurements with satellite-borne accelerometers. Results are correlated with solar and geophysical parameters. How research contributes - permits development of accurate density forecasting techniques. The objective of this work is to develop and fabricate one flyable omnidirectional atmospheric density accelerometer system. The instrument will be flown on a future Air Force low-altitude satellite. Atmospheric density is determined from measurement of the satellite deceleration caused by aerodynamic drag. It is anticipated that measurements will be made at altitudes from about 130 km to 400 km.

A satellite accelerometer flight unit with a single proof mass which is sensitive along three orthogonal axes will be developed. This will be accomplished by modifying the electronic design of a single-axis accelerometer presently used for satellite measurements. The proof mass is to be supported by electrostatic forces. An applied force causes the proof mass to tend to move in a direction opposite to the applied force. Measurement of this applied force along any axis is accomplished by determining the electrostatic forces which are required to recenter the proof mass. Extremely sensitive and accurate measurements of aerodynamic drag forces are made possible using this technique. The measured drag is directly proportional to atmospheric density. Three of these omnidirectional accelerometer systems will be developed, fabricated and tested. They will be flown on low-altitude satellites planned for launch in CY 1977 and 1978. The results are required for improved satellite navigation and for the development of improved atmospheric models for more accurate prediction of satellite orbits.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LK, L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0028, ISIS II DATA ANALYSIS
D.J. WINNINGHAM, Univ. of Texas, Graduate School, *Dallas, Texas* 75230 (DF278670; F19628-76-C-0005)

AF function - communications and detection. Deficiency - understanding ionospheric effects of particle precipitation in the arctic which degrade communications in that region. Objective - investigate the effects of auroral particle precipitation, measured by the ISIS-II satellite, on the ionization balance of the high-latitude ionosphere. How research contributes - provides inputs to in-house studies of particle precipitation on arctic ionosphere. This contractual effort is for the investigation of the effects of auroral particle precipitation on the production of ionization in the high-latitude ionosphere through the analysis and interpretation of soft particle spectrometer data from the ISIS-II satellite so as to provide a framework for the interpretation of data collected by the AFCRL Airborne Ionospheric Observatory, NKC-135 aircraft, number 53131.

Assemble and interpret ISIS-II soft-particle spectrometer data to specify the structure of the ionosphere in the region of the auroral oval and f-layer trough. Reduce particle data taken during selected aircraft periods for correlation with DMSP auroral photos and aircraft data. Investigate ability to use 6300 Angstroms photometer data as an indicator of FOF2 in the polar trough region.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory PH, L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0029, SATELLITE OBSERVATION AT MID-LATITUDES
L. KERSLEY, Univ. of Wales, *Aberystwyth, Wales, United Kingdom* (DF278620; AF-AFOSR-2267-72)

AF function - navigation. Deficiency - signal fading, pulse delays, refraction errors. Objective - measures ionospheric parameters related to geomagnetic activity. How research contributes - results used to develop predictive models of scintillation and total electron content for North Atlantic Region. Models support AFSATCOM and GPS development. This work continues correlations of observational data, from Sagamore Hill and Aberystwyth. Work is done in conjunction with the Joint Satellite Studies Group.

To record, reduce and analyze propagation data from transmitting satellites in order to characterize the North Atlantic radio environment.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory PH, L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0030, SATELLITE CIRRUS EVALUATION
K. LIOU, Univ. of Utah, School of Mines & Mineral Ind., *Salt Lake City, Utah* 84112 (DF245390; F19628-75-C-0107)

AF function - evaluate threat of reentry vehicles by hydrometeor erosion. Deficiency or opportunity - limited ability to identify erosive clouds from satellites. Objective - evaluate the ability of satellite instrument to estimate characteristics of ice clouds. How development contributes - establishes whether satellite observations can improve the remote sensing of cloud erosion potential.

Satellite instruments detect radiation which has undergone many complicated interactions with the earth's surface, atmosphere, and clouds. Many aspects of radiative transfer in ice clouds have been described numerically by the principal investigator and can be adapted to be compatible with the spectral properties of satellite instruments. By variations of such input parameters as cloud mass and particle size distribution, the ability of satellite instruments to determine cirrus cloud characteristics can be tested. Both visible and infrared radiation will be considered. The numerical cloud models will be used to improve the satellite estimation of cloud ice content under the Environmental Definition Program.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LY, L. G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

5.0031, NAVY ENVIRONMENT - SUPERGRADIENT WIND

E.C. KINDLE, Old Dominion University, School of Sciences & Health, *Norfolk, Virginia* 23508 (DN223437; N00014-75-C-0715)

Operation of Navy high-performance aircraft near the sea surface and naval combatants on the sea surface require accurate forecasts of surface winds so that effective operational planning can be realized. Current atmospheric synoptic forecast models from which surface winds are derived tend to grossly undercast wind speed in regions of strong air/sea thermal gradients. (The anomalous winds in question have been given the name 'supergradient'.) This research is directed toward an improved qualitative and quantitative basis for more accurate surface wind forecasts in regions of strong air/sea thermal gradients.

The contractor will develop a physical model of atmospheric processes which result in supergradient winds in the lower troposphere by statistically correlating extensive synoptic states of coastal winds in time and space, and concurrently will define and refine the physics of the time-dependent model presently being developed.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

LIFE SCIENCES

Includes Life Sciences (general); Aerospace Medicine; Behavioral Sciences; Man/system Technology and Life Support; and Planetary Biology.

6.0001, ASUPT NIGHT SCENE EVALUATION

D.F. CATANEO, U.S. Air Force, Human Resources Laboratory, *Chandler, Arizona* 85224 (DF222070)

To evaluate the extent to which simulator training using an ASUPT reduced-field-of-view night scene transfers to T-37 aircraft daytime training.

A data base on trials to proficiency in T-37 aircraft training on selected maneuvers has been developed in work unit 1123-01-14 under conditions of no ASUPT training and using the full ASUPT day visual scene. The proposed project will extend these data by providing training on selected maneuvers using the ASUPT night scene with a reduced field of view. A sample of UPT trainees will be trained using the same syllabus developed for the earlier study but restricting the ASUPT visual to a night scene and to a 28 degrees x 44 degrees FOV. Trials to criteria on each maneuver will be recorded in the aircraft and these data compared to those compiled in the earlier study.

ADDENDA: Supporting agency address is: AF Human Resources Laboratory FTS, Williams AFB, Arizona 85224

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0002, MAINTENANCE OF FLYING SKILLS FOR TACTICAL AIRCREWS

J.A. THORPE, U.S. Air Force, Human Resources Laboratory, *Chandler, Arizona* 85224 (DF222880)

To develop a procedure which operational training personnel can use to determine the content of a continuation training program. The way in which specific training tasks contribute to the proficiency of certain skills will be studied. The end product should provide guidance to an operational training team for developing a continuation program that integrates the aircraft, simulator, procedural and part-task trainers, and other training devices.

AFHRL/FT will communicate with operational tactical squadrons to determine the nature of continuation programs. Task frequency data will be collected to document what is presently being done during squadron sorties. A task taxonomy of tactical flying skills will be developed to relate specific task repetitions to the maintenance of specific skills. Task repetitions will be manipulated at operational units to determine the effect on skill level. These data will be used to specify the number of task repetitions in various types of training devices necessary to maintain flying skills for the tactical pilots.

ADDENDA: Supporting agency address is: AF Human Resources Laboratory FTT, Williams AFB, Arizona 85224

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0003, EVALUATION OF T-37 IFS SYLLABUS IN THE ASUPT

D.C. WEYER, U.S. Air Force, Human Resources Laboratory, *Chandler, Arizona* 85224 (DF222870)

To evaluate proposed syllabi for the T-37 IFS eliminating all instrument category training in the aircraft (with the exception of the instrument checkride), to develop training features, to determine requirements for console operator training, and to establish time- sharing procedures for the terrain model board. The subjects in the project will also be used in the validation of the ASUPT performance measurement system.

Four UPT students will be subjects. They will receive simulator training using the ASUPT in the basic, instrument and navigation categories of T-37 training. Evaluation in the basic category training will be a comparison of task frequency to proficiency in the aircraft as compared to a group undergoing normal training. Evaluation of the instrument/navigation category training will be comparison of instrument checkride scores with scores of students undergoing normal training. If, as a result of this study, significant revisions should be made to the syllabus, a second study will be performed to evaluate the revised syllabus.

ADDENDA: Supporting agency address is: AF Human Resources Laboratory FTS, Williams AFB, Arizona 85224

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0004, EFFECTS OF VARYING DISPLAY PARAMETERS ON TRAINING IN THE T-4G T-37 FLIGHT SIMULATOR

R.R. WOODRUFF, U.S. Air Force, Human Resources Laboratory, *Chandler, Arizona* 85224 (DF221810)

To investigate the effects of changing various engineering parameters of the T-4G (a T-37 flight simulator) on the training of Air Force undergraduate pilot trainees. Projects selected will complement future ASUPT research by investigation of variables which are fixed on ASUPT. Immediate plans are to evaluate the effect of black and white compared to color imagery and collimation compared to non-collimation of the image.

ATC instructor pilots will train groups of new student pilots to land the T-4G before they begin T-37 training. Separate, matched groups will receive equal training (i.e., number of trials) with different conditions (color, black and white, collimation, non-collimation, etc.). Students' performance at the end of training will be evaluated for differences or similarities in group scores. Performance will be measured in two ways: (1) IPS will evaluate performance using a 12- point scale like that developed for use in FFT studies, and (2) ADACS (automated data acquisition and control system) will be used to record several flight parameters. ADACS measures will be correlated with IP evaluations to determine which ones are most indicative of student performance and those selected will be used in subsequent analysis.

ADDENDA: Supporting agency address is: AF Human Resources Laboratory FTS, Williams AFB, Arizona 85224

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0005, TOXIC HAZARDS RESEARCH ENVIRONMENTAL TOXICOLOGY

T.T. CROCKER, Univ. of California, School of Medicine, *Irvine, California* 92664 (DF319590; F33615-76-C-5005)

This program will provide specific data and knowledge on the toxic properties of new materials, propellants, and other atmospheric contaminants used or encountered by Air Force personnel in the development, test, and operational phases of new aeronautical, aerospace, missile, and orbital systems. The results of this program, in conjunction with the over-all toxicology program, will provide the Air Force and other governmental agencies with tolerance criteria to provide for the optimum protection of Air Force and other Department of Defense personnel. Pertinent toxicological information will provide guidance to design engineers in order to develop aeronautical, aerospace vehicles, and launch systems with maximum functional capability. Results will also be used for the development of design criteria for pollution-abatement procedures and equipment.

The contractor shall maintain and operate the toxic hazards research unit and conduct toxicological research on a wide variety of current and advanced USAF research and development materials. Emphasis is upon the applied inhalation research area. The spectra of occupational inhalation exposures that will be investigated begin with accidental, short-term, high-level exposures, include occupational daily, 8-hour, industrial exposure, and culminate in truly uninterrupted, long-term continuous exposure as experienced during confinement in sealed habitable atmospheres. In addition, the effort shall provide definitive data concerning the environmental impact of selected Air Force materials through the use of representative aquatic and plant species. This R & D effort to develop environmental pollution toxicity criteria for Air Force chemicals is a firm AFSC requirement as outlined in AFR 19-1 and AFR 19-2.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab TH, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0006, HUMAN PERFORMANCE MEASUREMENT IN AIR SYSTEMS

D.A. NORMAN, U.S. Navy, Human Factors Laboratory, *Orlando, Florida* 32813 (DN221040)

To improve control of the training process and of computer-based training systems, in particular, through development, test and evaluation of a comprehensive subsystem for the measurement of human performance. The availability of precise and relevant assessment structures can increase training effectiveness by giving a true picture of skill acquisition level at any point in the training process.

Identify appropriate training settings; select a class of desired trainee behaviors for exhaustive analysis; define and implement a measurement structure based on a measurement subsystem of adequate complexity; conduct empirical tests to evaluate techniques for discriminating among candidate members of a measurements pool; investigate the utility of highly refined measurement subsystems in training process control, e.g., ability to predict the trainee's readiness to transfer.

ADDENDA: Supporting agency address is: Naval Air Systems Command, Human Factors, Washington, DC 20360

SUPPORTED BY U.S. Dept. of Defense - Navy

6.0007, INVESTIGATION OF SIGNAL ANALYSIS TECHNIQUES FOR ECG/VCG CLASSIFICATION

D.E. GUSTAFSON, Mass. Inst. of Technology, Charles Stark Draper Lab., *Cambridge, Massachusetts* 02139 (DF318720; F41609-76-C-0009)

The USAF Central Electrocardiographic (ECG) Library, established to assist in the validation of criteria for the selection/retention and medical maintenance of flying personnel, has, to date, accumulated more than 760,000 individual ECG records. The purpose of this contract is to continue development of algorithms, based on signal analysis techniques, for classifying both electrocardiograms and vectorcardiograms (VCGs). This is the fourth step in a continuing research program, the ultimate objective of which is the automated separation of ECGs into abnormal and questionable categories. It is anticipated that successful completion of this contract will result in the extension of present algorithms and development of new algorithms.

The overall research approach will consist of two categories of investigation, with all development work evaluated using actual ECG/VCG data: (1) further investigation of feature extraction using Karhunen- Loeve (K-L) expansion and determination of the appropriate ensemble correlation matrix; (2) investigation of clustering techniques by means of unsupervised learning to investigate 'natural' clustering of data, employment of supervised learning based on cardiologist diagnoses to enhance class separability, and a combination of both the above to give overall best class separation in feature space and maximize pattern recognition accuracy.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine NG, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0008, PROTECTION OF THE CARDIOPULMONARY SYSTEM AGAINST THE INJURIOUS EFFECTS OF ACCELERATION

P.A. CHEVALIER, Univ. of Minnesota, School of Medicine, *Rochester, Minnesota* 55901 (DF032170; F49620-76-C-0001)

AF FUNCTION: Aircrew members may be exposed to high, sustained, rapid-onset, gravitational forces in present and planned aircraft. The lungs and associated structures are particularly vulnerable to acceleration stress with resultant operator performance degradation and incapacitation. Deficiency - increased knowledge of the mechanical characteristics and dynamic geometries of the lung is needed to understand the factors which determine man's reaction and tolerance to changes in the force environment.

OBJECTIVE: Techniques for measuring tissue positions plus algebraic reconstruction will be used.

HOW WORK CONTRIBUTES: Understanding of the processes involved should lead to development of efficient means of combating the effects of extreme changes in gravitational-inertial force environments. This research supports on-going AMD programs and has applicability to the civilian sector.

The work will use the parenchymal marker technique to study the dynamic spatial distribution of lung parenchymal strains and using the cross-section reconstruction techniques will study the dynamic geometry of the respiratory system.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NL Bldg. 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0009, DISPLAY CONCEPT DEVELOPMENT

J.H. BRINDLE, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF319100)

This work unit will develop operator-centered display technology for AF real-time reconnaissance and weapon delivery functions applicable to manned and unmanned systems. Display concepts will be formulated and prototype equipment developed to enhance man's visual ability to interface with various state-of-the-art and advanced development reconnaissance weapon delivery and teleoperator subsystems. These concepts include visually-coupled control/display devices (helmet- mounted sight/display), virtual image display techniques, holographic lens projection techniques and display signal processing/enhancement. Consultation will be provided for further design, development, and deployment of systems based on these concepts. This work unit supports advanced display concept work associated with ASD TN-72-46, high- acceleration cockpit, SCO.RS/3 low-altitude tactical reconnaissance, TPG CA-RTA, digital avionics man-machine interace, AFAL ADP 698D, advanced avionics for navigation and weapon delivery, and AGM-65, Maverick air- to-ground missile. Efforts are coordinated with the Naval Air Systems Command, Army Night Vision Laboratory, Air Force Flight Dynamics Laboratory, Air Force Avionics

Laboratory, Air Force Armament Laboratory, Aeronautical Systems Division, Air Force Office of Scientific Research, and the Advanced Research Project Agency.

Promising state-of-the-art technology in optics, electrooptics and signal processing components will be applied to develop and evolve operator display subsystems and concepts which enhance overall operator performance in target acquisition and weapon delivery tasks. These display concepts will use unique psychovisual and cognitive processing capabilities of the human operator. Solid-state matrix-element image sensing and generating devices will be integrated with new techniques, including holographic diffraction optics, to project images to the operator's visual field. Development of variable resolution and color virtual image displays will be continued. Two-dimensional spatial filtering, color enhancement, pseudo-stereo effects and image multiplexing will be demonstrated and their effects on target acquisition defined in the display/image metric laboratory. (Text Abridged.)

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0010, BIODYNAMIC DESIGN CRITERIA FOR EMERGENCY ESCAPE SYSTEMS

J.W. BRINKLEY, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF312330)

To develop acceleration exposure limits and protection equipment requirements for operational and advanced ejection seats and crew escape modules. The effort will result in the development of new escape system specifications and upgrading of existing specifications in the U.S. Air Force aerospace systems development program in order to minimize personnel injury during emergency escape.

Acceleration and windblast environments currently experienced with operational escape systems or predicted for advanced systems will be studied analytically and experimentally to develop human exposure limits. The exposure limits will be expressed in terms of mathematical analogs and verified by comparison with current operational injury rates associated with specific environments and by tests using human subjects. The resulting analogs will be used to study the degree of protection or hazard provided by specific personnel equipment configurations. The study results will be verified experimentally.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab BB, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0011, DIGITAL INFORMATION SYSTEM PERFORMANCE ASSESSMENT

B.M. CRAWFORD, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF319210)

The objective is to develop and verify compatible taxonomies and metrics for Air Force crew performance capabilities consistent with the functional requirements and mission objectives of advanced digital information processing and presentation systems. The verified taxonomies and metrics will be used to establish human engineering design criteria and man-machine functions allocations for advanced systems and to evaluate alternative concepts for proposed systems on the basis of systems and functions analyses. Potential applications of the resultant techniques include digital avionics information system ADP efforts and advanced command-control system development programs.

Hypotheses as to 1) the nature of behaviors required by representative crew perceptual, cognitive, and performance functions in digital information system context, e.g., advanced all-digital cockpits, and 2) quantitative estimates of associated workloads will be made on a priority analytic basis using established behavioral taxonomies, e.g., psychomotor response execution, etc., and information theory metrics, i.e., uncertainty reduction or information processing rate in bits/sec. The resultant hypotheses will be tested experimentally in simulated systems with man-in-the-loop performing primary crew functions with measures derived from compatible secondary loading tasks used to complement measures of primary task performance in assessing workload and reserve capacity for the various behavioral capabilities.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab HE, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0012, MANUALLY GUIDED MISSILES

C.N. DAY, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF318960)

To provide human operator effectiveness estimation for use in threat analysis of a broad class of manually guided missiles. These human operator models and system effectiveness analyses will be used by U. S. Army electronics command and AF Avionics Laboratory countermeasure programs to evaluate the effectiveness of countermeasures against the human operator subsystems. Further refinement of attrition modeling in threat estimation (USAF/SA, FTD, DIA) and in mission analysis (ASD/XR, ADTC/SR) will also result.

Laboratory man-in-the-loop simulation data from visual and electrooptically directed threat weapons will be collected in FY75 and FY76. Data from an electrooptically guided missile system of priority to the avionics laboratory will be approached in FY76 from the FY75 simulation. Analysis to potential threat quantification will take place in FY77.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab EM, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0013, AIR FORCE PERSONNEL EQUIPMENT FOR PROTECTION IN IMPACT AND ESCAPE SYSTEM ENVIRONMENTS

J.P. KILIAN, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF312320)

The purpose of this effort is to provide improved personnel protection equipment such as restraint systems, body support devices, landing impact attenuation systems, and to describe designs for equipment in terms of dynamic mechanical properties as well as performance characteristics. The result of this effort will be the development of improved design criteria for operational and advanced system acceleration protection equipment for aircrews.

The approach is to relate the mechanical properties of specific operational or exploratory protection components to their effect on the human body response to acceleration environments. Both analytical and experimental mechanical system model techniques are employed using in- house and contractor capabilities. Additional emphasis will be placed on the development of new protection system concepts. Also involved is the development of new design evaluation techniques and application of existing evaluation techniques to determine adherence of specific designs to established or development design criteria.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab BB, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0014, PILOT MODELS FOR PERFORMANCE MEASUREMENT

P.A. KNOOP, U.S. Air Force, Human Resources Laboratory, *Dayton, Ohio* 45433 (DF228090)

To determine which pilot modeling techniques are compatible with the objectives of performance measurement and to develop a rationale for performance measurement through modeling which will guide future work in this area. The work is in support of an effort to explore and exploit the measurement potential of pilot modeling methods for application in instructor station design and simulation R & D.

The approach is to first conduct a survey of existing pilot modeling techniques by both a literature review and coordination with organizations actively engaged in pilot modeling research. The principal advantages and shortcomings of each technique, with respect to applications in performance measurement, will be identified, and the extent to which each technique accurately incorporates contemporary behavioral theories will be assessed. Those techniques with greatest potential payoff for measurement applications, along with related research voids, will then be

identified. Milestones are as follows: (1) survey technical literature and on-going pilot modeling work, 30 Apr 76, (2) develop summary of existing modeling techniuqes, 31 May 76, (3) complete analysis of modeling methods with respect to measurement potential, 31 Oct 76, (4) develop documentation (TR), 5 Jan 77.

ADDENDA: Supporting agency address is: AF Human Resources Laboratory ASM, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0015, DEVELOPMENT OF RIGOROUS SIMULATOR TEST CRITERIA

J. LOCH, U.S. Air Force, Human Resources Laboratory, *Dayton, Ohio* 45433 (DF227530)

To develop a revised set of flight performance test criteria for military specification MIL-T-9212B(USAF), general requirements for trainer, flight simulator, aircraft. The specific paragraphs under review shall be 4.4.10 through 4.4.29. The purpose of the rewrite of the specification will be to simplify the test while maintaining testing integrity.

The study will (a) review the tests as currently defined in 9212B, (b) review previous use of the military specification by studying recently procured test guides, (c) review the mathematical model being verified by the tests, to determine if possible duplication exists, and (d) review current aircraft flight-test techniques to determine the applicability of same. The results of this in-house program will consist of a technical report defining suggested modifications to the military specification. The changes will be of three types, suggested test revisions, new tests, and test deletions.

ADDENDA: Supporting agency address is: AF Human Resources Laboratory ASM, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0016, MANPOWER PREDICTION MODELS FOR SYSTEM SUPPORT REQUIREMENTS

F.A. MAHER, U.S. Air Force, Human Resources Laboratory, *Dayton, Ohio* 45433 (DF227540)

The major objective is to construct and verify models and procedures for predicting the impact of aerospace ground equipment (AGE) and hardware spares upon human resource requirements and establish trade-off potential positions. The intent is to predict human resource information that may be used for design trade-off decisions and for life-cycle cost estimations. This will assist in insuring that a developing weapon system will be capable of operating efficiently within the limits of an established support budget.

Previous simulation techniques developed under task 112404 will be used as the foundation for the modeling effort. A data collection system relating human resource requirements to AGE and spares demands will be developed. The modeling of AGE and spares related maintenance will be accomplished by basic model modification, merging available peripheral programs, and by developing new satellite programs. The final product will be a model which includes the variables of AGE and spares in addition to those variables already simulated in the work being completed under work unit 1124-04-03 which will be terminated by November 1974.

ADDENDA: Supporting agency address is: AF Human Resources Laboratory ASR, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0017, ASUPT G-SEAT CONFIGURATION SIMULATION

R.L. MAKINNEY, U.S. Air Force, Human Resources Laboratory, *Dayton, Ohio* 45433 (DF228040)

To investigate simpler g-seat hardware configurations for the purpose of describing a low-cost approach to 'g' cueing for future simulators. The results will be applied to the design of the advanced low-cost g-seat being developed under project 1958-02-01.

The approach is to take advantage of the flexibility of the ASUPT g-seat software and to constrain bellows or groups of bellows such that larger surface areas for the seatpan and backpan can be simulated. The simplest approach will be to investigate a three-component seat compared to ASUPT's 32-component capability. Only the lap belt and two seat pin bellows will be actively driven. In driving the lap belt plus the two bellows under the buttocks, a very simple three-component g-seat will be simulated. From this basic configuration, additional seat and backpan configurations will be tried. In-house IPS will fly the different seat configurations and evaluate back configuration's effectiveness in simulating g-cues as compared to the full-capability g-seat configuration.

ADDENDA: Supporting agency address is: AF Human Resources Laboratory ASM, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0018, MECHANISMS OF NOISE GENERATION, PROPAGATION AND RECEPTION AS RELATED TO AIR FORCE BIOACOUSTIC PROBLEMS

R.G. POWELL, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF313020)

Many USAF operations (e.g., aircraft on the ground and in flight, engine test stands, escape systems, auxiliary equipment) produce high noise levels in areas where man must function. These levels frequently cause serious problems concerning communication, hearing loss, annoyance and performance. This work unit provides (1) knowledge and engineering methods necessary to calculate these environments and (2) quantitative information on the physical mechanics involved in the generation of speech and man's response to acoustic energy (in support of task 7231 03).

Conduct theoretical and experimental studies on (1) the basic mechanisms by which acoustic energy is generated, (2) the means by which this energy is propagated, and (3) the physical response to such energy. Perform statistical analyses of experimental data, and develop theoretical models to arrive at generalized relationships between noise source characteristics and the aerodynamic, mechanical or thermodynamic characteristics of the source using such techniques as dynamic- similarity models or electromechanical-acoustical analogs.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab BB, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0019, TOLERANCE LIMITS AND MECHANISMS OF FAILURE OF THE SKELETAL SYSTEM UNDER IMPACT CONDITIONS

G. GRAVES, Univ. of Dayton, Res. Inst., *Dayton, Ohio* 45409 (DF318280; F33615-75-C-5008)

This effort supports in-house research to define the mechanical properties, bone dynamics, failure and tolerance limits of the skeletal system. This allows analysis of the mechanical factors which result in bone fractures and injury to the skeletal system under impact conditions. This includes emergency egress from aircraft, crash and hard landings, and other operational conditions in which large magnitudes of force must be taken by the skeletal system. Information is required to define man's ability to tolerate the mechanical stresses associated with present and future operational Air Force environments.

Analysis of the failure properties and tolerance limits of bone structures will be performed. In vitro skeletal failure conditions of the type which produce human injury are simulated using the primate model. Appropriate scaling laws allow prediction of human skeletal behavior to impact conditions. The mechanical properties of bone structures correlated with histological, physical, and biochemical parameters allowing definition of the factors which act to maintain normal bone strength and which define tolerance limits of skeletal structures. This effort has important preventive implications in regard to human injury and is directed towards defining the failure limits to which man may be subjected.

Addenda: Supporting agency address is: 6570 Aerospace Medical Rsch Lab BB, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0020, HYDROXYLATED, CONJUGATED & EXCITED-STATE DERIVATIVES OF BENZOIC ACID IN BODY FLUIDS AS STRESS INDICATORS IN AIRCREWMEN
B.F. BURGESS, Univ. of Pennsylvania, School of Medicine, *Philadelphia, Pennsylvania* 19104 (DN481101; N62269-73-C-0571)

To determine O-hydroxy hippuric acid and related hydroxylated, conjugated and free radical derivatives of benzoic acid in the urine of humans exposed to stressful aerospace environments. The goal is to achieve predictive indices of stress intolerance which will reveal the exhaustion of adaptive mechanisms and the onset of pathology. This contract supports work unit DG102, agency accession no. DN333005.

Thin-layer and high-pressure liquid chromatography will be used in conjunction with e.s.r. and fluorescence spectrophotometry to detect and quantitate the organic solvent soluble components extractable from the acidified urine of control and stressed military flight personnel. Results will be correlated with other stress indicators like blood phospholipids to achieve a biochemical indication of stress pathology.

ADDENDA: Supporting agency address is: Naval Air Development Center, Crew Systems Department (4033), Warminster, Pennsylvania 18974

SUPPORTED BY U.S. Dept. of Defense - Navy

6.0021, EXTREMITY HEATING IN AIRCREWMEN EXPOSED TO COLD
L.J. SANTAMARIA, U.S. Navy, Crew Systems Department, *Warminster, Pennsylvania* 18974 (DN481051)

To determine the effects of heating the extremities on total body conditioning in the cold, stated as a new research requirement in the FY-1974 Naval Aviation Biomedicine/Human Effectiveness Technical Workshop Report.

Using a liquid conditioning garment through which warm water flows, three subjects varying in body configuration and wearing appropriate protective clothing are exposed to different environmental conditions of dry cold and cold water immersion. The dry cold environment consists of air temperatures of -17.8 C (0. F), -67 C (20 F) and 0 C (32 F) with minimal wind velocity; the immersion environment involves water temperatures of 32 F with 20 F air temperature and of 45 F water temperature with 32 F air temperature. Wind velocity in the immersion cold is maintained at 15-20 mph. In the water exposures, the subject is enclosed in an inflatable life raft following a 2 min. initial immersion simulating release from an aircraft and/or personal restraint system. Inlet water temperature is maintained constant at different temperature levels. The assessment of the effectiveness of liquid heating of the extremities is based on pertinent physiological measures and subjective reactions recorded in the course of exposure.

ADDENDA: Supporting agency address is: Naval Medical Research and Development Command, National Naval Medical Center, Bethesda, Maryland 20014

SUPPORTED BY U.S. Dept. of Defense - Navy

6.0022, DEVELOPMENT OF MULTIPLE LOGISTIC RISK FUNCTION FOR AIR FORCE PERSONNEL
R.A. ALBANESE, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF317470)

Air Force personnel are simultaneously exposed to unique stresses as well as a variety of stresses in common with the civilian population. The probability of survival, or its complement the risk function, has in some cases been expressed in terms of a single stress. A method of expressing individual probability of survival is needed as a function of simultaneous exposure to specified various degrees of several Air Force stresses. This effort will develop the cumulative multivariate logistic as a tool and explore its usefulness for risk identification in various AF situations.

A method of fitting the cumulative multivariate logistic to a set of data on our computer facilities will be developed from existing methods and computer programs. This method will then be used to explore (1) the suitability of civilian population parameters, such as those of the Framingham Study for Cardiovascular Heart Disease, in evaluating the risks of Air Force personnel, and (2) the practicability of using the technique for other Air Force groups and other risks of mission failure.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine BR, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0023, TEST AND EVALUATION OF MEDICAL MATERIEL ITEMS FOR FIELD OPERATIONS AND AEROMEDICAL EVACUATION
M.J. CHANDLER, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF311890)

To test and evaluate newly developed commercial or in-house- developed items of medical materiel to determine their efficacy of use in aeromedical airlift. The biomedical systems branch has a continuing effort of evaluating medical materiel items to satisfy identified operational requirements for aeromedical airlift. Performance criteria must be established for insuring the medical equipment items meet stated operational requirements of the aeromedical mission, and are fully compatible with aeromedical staging facilities, surface transport systems, and field hospitals. Current state-of-the-art of medical materiel technology will be continually assessed.

The test program is normally comprised of six major areas: patient-user safety, operational specifications, environmental effects, electrical and mechanical characteristics, and human factors. Each area is further subdivided into specific engineering tests or evaluations. When the test program is completed, test data are compiled and reviewed. A report, stating whether the evaluated medical item is or can be made acceptable for aeromedical airlift use, is prepared and disseminated to personnel in aeromedical airlift systems. A file is maintained and the information updated and modified by reports from field medical personnel who are using the medical items in the aeromedical airlift systems.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine NG, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0024, IN-FLIGHT ENVIRONMENTALLY CONTROLLED TRANSPORT FOR LARGE INFANTS
M.J. CHANDLER, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF318070)

A letter from MAC/SGAH, 29 November 1973, Aeromedical Evacuation Support for Military Airlift Command, identified a requirement for a larger transport incubator than the one provided under development 4054- 13-07. The objective of this work unit is to provide an infant transport that will control the interior environment and accommodate infants up to 27 inches in length. The transporter must control interior temperature and ventilation rate, have provisions for adding water vapor to increase interior humidity, and have a means for introducing oxygen from external sources. The unit must minimize disturbance of the internal environment while allowing access to the infant. The unit must be able to operate from 12 vdc, 24-28 vdc, 110-120 fac, 60 hz and 110-120 fac, 400 hz. The unit must also be provided with a portable battery power supply capable of operating the unit for 2 hours in a 60 degrees F ambient environment.

During test and evaluation of infant transporters, designed primarily for premature infants (projects 7996-02- 21 and 4054-13-07), a transporter manufactured by Mistogen Corporation with a bassinet measuring 27 inches long by 14 inches wide was obtained for evaluation. Preliminary evaluation indicates this transporter, as presently configured, does not meet the requirements of MIL-STD 461A for electromagnetic compatibility and does not provide adequate ventilation. Other minor deficiencies were also identified. Modifications will be made in an attempt to make this unit acceptable while surveying the commerical market for other units that may satisfy this requirement wholly or in part.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine NG, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0025, IN-FLIGHT FEEDING, NUTRITION AND WASTE MANAGEMENT
J.C. CRIGLER, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF320250)

USAF weapons systems necessitate unique personal life support requirements. This effort provides a flexible in-house capability to identify and provide workable solutions to special problems in the areas of inflight feeding, nutrition, human waste management and water potability relative to nominal, alert and contingency missions. In addition, food technology and products developed by industry and the government will be monitored through a 'technology watch' to insure that personal support systems are the best possible for supporting man under stringent mission requirements. The DoD food and engineering program also will be closely monitored to insure that Air Force in-flight feeding systems are adequately supported.

Monitoring of USAF weapons systems and mission requirements will continue in an attempt to determine types of food, food preparation equipment and facilities, packaging materials and human and food waste management procedures that are necessary to insure mission completion. Major emphasis will be placed on the determination of trade-offs between these areas of concern and specific mission requirements with reliability, crew acceptance and cost effectiveness as primary considerations.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine VN, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0026, ANALYSIS TECHNIQUE FOR ESTABLISHING TOLERANCE TO AF STRESSES

P.P. CRUMP, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF315150)

Air Force studies to determine the tolerance levels of aircrew and support personnel to various operational stresses utilize statistical techniques to minimize the number of costly observations required and to maximize the assurance from observations made. State-of-the-art statistical analyses are appropriate for some of these data but not for others. This effort will identify the inappropriate situations and will furnish new or adapted techniques for such cases. The end result will be to avoid erroneous conclusions from improper analyses and to reduce the number of experimental procedures required to establish any particular tolerance or exposure limit.

Techniques to be developed will be identified in two ways--both based on the observed characteristics and needs of data encountered in the Biotechnology Exploratory Development Program at the School of Aerospace Medicine. First, we will identify those situations for which the state-of-the-art techniques rest on assumptions or derivations which have questionable validity. Second, we will follow the presentations of new techniques at meetings and in the literature in order to identify those which can be adapted to improve our analyses. After identification each technique will be studied by analytic methods whenever possible, otherwise by simulation methods (Monte Carlo).

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine BR, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0027, DEVELOPMENT OF TECHNIQUES TO MEASURE CIRCULATORY AND RESPIRATORY FUNCTION IN FLYING PERSONNEL

V.F. FROELICHER, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF311490)

In support of programs to minimize the cost of diseases of the circulation and respiration to the USAF flying population, it is necessary that more sensitive physiological measurement techniques be developed and applied. This effort will accomplish this, and will establish normal value ranges specific for the flying population and the effect of disease on these values.

Cardiopulmonary measures will be obtained for different age groups of normal aircrewmen and those having cardiopulmonary disease during dynamic stress testing and pulmonary function testing. Automated techniques for analyzing the exercise electrocardiogram, echocardiogram, and left ventricular angiography are being added to a long-range study.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine NG, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0028, EFFECTS OF NOISE ON HEARING ACUITY AND FUNCTIONAL ABILITY OF FLYING PERSONNEL IN AF OPERATIONAL ENVIRONMENTS

D.C. GASAWAY, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF311650)

USAF weapons systems are associated with production of acoustic energy (noise) sufficient to require protection of aircrew and ground support personnel. Loss of highly trained flying and maintenance personnel and compensation for hearing loss continue to be major Air Force problems. The objective of this effort is to determine effects of noise encountered in USAF airborne and ground operations on the hearing of personnel routinely exposed to this hazard in performance of assigned duties, and to validate auditory risk criteria, adequacy of ear protection and noise control measures, and criteria and procedures for disposition of noise-exposed personnel who demonstrate significant shifts in hearings.

AF form 1490 and 1491 and associated disposition documents received at the USAF Hearing Conservation Data Registry will be subjected to quality control and then processed by automated techniques. Read-outs will be used to continually appraise the USAF Hearing Conservation Program at every operational facility. Instrumentation utilized in monitoring audiometry, personal ear protection, and disposition of personnel will be assessed on a continuing basis. Methods and techniques used to monitor individuals exposed to noise will be routinely evaluated and deficiencies identified. Auditory acuity of various categories of personnel will be studied. Corrective actions made evident by completed studies will be recommended to command surgeons and HQ USAF/SGP as appropriate.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine NG, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0029, ANALYSIS OF TRACE METALS IN BIOLOGICAL SAMPLES FROM AIRCREW PERSONNEL

R.O. HUGHES, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF316940)

The objective of this effort is to develop methods of trace metal analysis applicable to biological specimens, to apply trace metal analysis techniques on a routine basis to patients seen by the Aeromedical Consultation Service, to ascertain the association of changes in trace metal content in biological specimens with the presence or absence of cardiovascular and metabolic diseases, and to ascertain the usefulness of trace metal analysis as a predictive and diagnostic tool for the detection and/or prevention of cardiovascular and metabolic disease in the Air Force flying population.

The relationship between changes of trace metal content in biological specimens and the development of cardiovascular disease, hypertension and diabetes has been extensively documented in the literature. These disease processes are important causes of morbidity in Air Force flying personnel. Recent advances in instrumentation have afforded the Clinical Pathology Branch the capability of determining minute amounts of trace elements in biological specimens. Reliable and clinically reproducible methods for determining these trace metals in biological specimens will be developed. Their positive or negative correlation with cardiovascular and metabolic diseases will be studied in patients referred to the Aeromedical Consultation Service.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine NG, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0030, DEVELOPMENT OF A PILOT SELECTION SYSTEM

D.R. HUNTER, U.S. Air Force, Human Resources Laboratory, *San Antonio, Texas* 78236 (DF232530)

To collate results of pilot selection studies conducted by AFHRL over the previous 7 years and to use that base for making recommendations for further research and for pilot selection systems that could be implemented by Air Training Command.

The results from previous pilot selection studies conducted by AFHRL will be analyzed and the relative merits of each of the proposed selection instruments considered. The relative contribu-

tions of each of the instruments to prediction of pilot training outcomes will be considered in recommending the development of a pilot selection system, as will the practical problems of implementing such a system. Based upon the previous studies a course of research will be proposed to cover improvements in existing and proposed selection systems along with promising avenues of research that have not been fully explored.

ADDENDA: Supporting agency address is: AF Human Resources Laboratory PES, Lackland AFB, Texas 78236

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0031, IMPACT OF INTEREST AND MOTIVATION ON TASK PERFORMANCE AND JOB SATISFACTION

K.G. KOYM, U.S. Air Force, Human Resources Laboratory, *San Antonio, Texas* 78236 (DF232440)

A broad-range satisfaction research program has evaluated the impact of work-related factors on job satisfaction and career decisions without investigating vocational interest, motivational, and performance measures. Correlational/causal relationships between job satisfaction and airmen's task level performance will be examined, and amount of job attitude variance attributable to vocational interest and self- motivation will be determined.

Preliminary data to be analyzed already exist for three career ladders: Communications Center Operations, 291x0, Ground Radio Communications, 30x4, and Aircraft Maintenance, 431x1C. Using multiple regression analysis, the unique contribution of task-level job performance ratings and related motivation and vocational interest measures to job satisfaction will be examined. Analyses will look at man/job and satisfaction/performance relationships.

ADDENDA: Supporting agency address is: AF Human Resources Laboratory ORE, Lackland AFB, Texas 78236

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0032, SIGNIFICANCE OF DISEASES OF THE CIRCULATION AND RESPIRATION IN AIRCREWMEN

M. LONGO, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF311480)

In minimizing the number of flyers who must be grounded because of the presence of circulatory and respiratory diseases, it will be necessary that the significance of the abnormal response to testing procedures in regard to flying performance and safety be better quantified. This effort will accomplish this by establishing the functional and prognostic nature of abnormalities through long-term follow-up employing newly developed measurement techniques.

New approaches allow more precise evaluation of cardiovascular functional integrity and capability in the presence of abnormalities, allowing retention of many crewmen in flying duties not previously possible. These techniques improve ability to detect potential problematic disease earlier and permit a more productive preventive approach. Longitudinal studies to assess the significance of disease in aerospace operations, coupled with intensive study of patient groups with specific problems (e.g., right bundle branch block) will yield definitive information to help formulate or modify medical standards.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine NG, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0033, RE-EXAMINATION AND EVALUATION OF REQUIREMENTS/CONCEPTS FOR HIGH-ALTITUDE PROTECTIVE EQUIPMENT

T.R. MORGAN, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF316310)

Mission profiles attainable by present and projected high-performance aircraft expose the crewmember to a variety of potential physiological hazards. These include cabin decompression, oxygen equipment malfunction, and/or air conditioning failure. Accordingly, a vast array of emergency equipment and procedures have been developed to protect the flyer in the event of critical systems failure. Although providing acceptable physiological protection, many of these measures have been criticized by the crewmember as involving unacceptable encumbrance, discomfort, distraction and/or fatigue. The safety afforded during occasional high-altitude penetration may be more than offset by continuing limitations of mobility and visibility in the intermediate/low-altitude (air combat) envelope. Limitations inherent to the use of existing equipment thus require reexamination of present use and design criteria, coupled with efforts to evaluate their applicability in present and projected weapon systems. Work unit objectives include (1) continued monitoring of new technology available from USAF, NASA, and foreign sources, (2) use of this information to assess present/projected equipment use and design criteria, (3) the conduct of in-house studies to develop/verify these criteria, and (4) assistance in development and evaluation of new equipment desired by using agencies. This work is done in support of ASD/ENCCE Technology Need, May 72, HQ ADC/SG letter to ASD, 10 Mar 72, HQ TAC/DLRS TWX, 18 Oct 72, HQ SAC TWX, 10 May 74, ASD/SML letter, 19 Jul 74 and ESP 921E- 9392-0006 in support of NASA/JSC.

Contact and coordination now established with various agencies and committees will be maintained with continued monitoring of new technology developed by industry, NASA, other USAF sources, and applicable intelligence data. Studies addressing definition of equipment design criteria will be implemented. Liaison with using agencies will be continued, and assistance with desired test/development requirements provided where possible. Analyses of existing technology, and its application to present and projected mission requirements, are continuing and will serve as a basis for any in-house and contractual endeavors. (Text Abridged.)

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0034, PERFORMANCE AND PSYCHOBIOLOGIC FACTORS IN CREW FATIGUE

W.F. STORM, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF319420)

The USAF continues to experience a drawdown in personnel, number of aircraft in the inventory, and acquisition of new weapon systems. This requires that existing resources be employed in new and/or more demanding ways, pushing crews to work schedules and workloads not previously experienced. The objective of this work unit is to investigate the psychologic loads imposed on crews performing USAF missions under these more demanding loads. Quantitative and qualitative measurement technologies will be developed and applied to these augmented workloads to include (a) cyclic effects, (b) time zone and deployment effects, (c) erratic work schedules, and (d) psychobiologic processes involved in task demands, overall workload, and recovery processes. This effort complements 7930-09-01, Physiology of Sustained Operations.

Field studies are the essential environment in which this research is conducted. Data are obtained prior to, during and after periods of extensive work such as exercises, trials of new weapon systems employment and special operations, as well as more routine operations in which problems of performance, morale, and motivation have arisen. Measurement techniques include rating by peers and experts, survey and questionnaires, subjective and objective fatigue assessments, sleep histories, and the time course of recovery in all these measures. Corrective procedures in these areas are identified and applied where possible within existing operational constraints and demands.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine VN, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0035, ASSESSMENT OF HEARING IN FLYING PERSONNEL

H.C. SUTHERLAND, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF311640)

The ability of USAF personnel to hear and understand auditory communications is critical to the Air Force mission. This effort is directed toward development and/or validation of equipment and procedures to quantify hearing ability in the development of hearing standards and in assessing the impact of various types and degrees of hearing loss on communication capability.

The response of human subjects to pure tones, speech and noise are studied in the laboratory and, if indicated, in the field. New or improved techniques and instruments are evaluated concerning their ability to measure the auditory function of flying personnel, with or without hearing impairment. Preliminary operational assessments will be utilized in the evaluation of new tests when appropriate.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine NG, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0036, OPTIMIZATION OF PHYSIOLOGIC PROTECTIVE MANEUVERS FOR AIRCREW IN A HIGH G ENVIRONMENT

S.B. WILEN, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF318790)

The objective of this effort is to examine the effects of modifying a variety of physiologic parameters--either singly or in combination--on improving (or reducing) plus gz tolerance in human subjects or aircrew members. For example, CO2 breathing and positive pressure breathing appear to improve g tolerance while 100 percent O2 breathing has a deleterious effect. It is not known what the effect will be when a combination of physiologic perturbations is imposed on the aircrew member, i.e., increased CO2 combined with increased temperature and dehydration. This effort is designed to determine the optimum environment in which the fighter pilot should function in order to achieve maximum effectiveness for himself and his aircraft.

The USAFSAM human centrifuge will be used as a controlled simulator for duplicating air combat maneuvering g forces. By monitoring a variety of physiologic parameters such as O2 uptake and CO2 production, blood pressure, heart rate and rhythm, arterial O2 saturation, and others, it may be possible to predict changes in tissue O2 levels during g that will subsequently affect g tolerance. The influence of cumulative g and repetitive g on g on physiologic systems while the subject is experiencing a variety of external changes to his normal environment will be examined. The cardiopulmonary system will be the major area examined for acute and/or chronic changes.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine VN, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0037, THE SIGNIFICANCE OF DISEASES OF THE MOUTH AND TEETH IN FLYING PERSONNEL

A.S. WINDELER, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF312110)

This work unit is based upon and contributes to the studies accomplished on flying personnel by the aeromedical consultation service of the USAF School of Aerospace Medicine. The objective of this effort is to determine the incidence and special significance to the flyer of diseases of the mouth and teeth, and to respond to R and D efforts specifically requested by the Air Force Surgeon General's Office, subsequent to AMD/RD review.

Baseline study of general oral health will be made by age group in flying personnel referred to the Aeromedical Consultation Service. The significance of oral pathology in the flight environment will be established by dental history in affected crewmen, and by studies of similar groups in the course of altitude chamber flights for training or research purposes. An investigation into the present modification of base water supplies using germ-free animals will be done to determine the mechanism of action which will increase the effectiveness of fluoridated water on military personnel and dependents over twelve years of age.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine NG, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

MATHEMATICAL AND COMPUTER SCIENCES

Includes Mathematical and Computer Sciences (general); Computer Operations and Hardware; Computer Programming and Software; Computer Systems; Cybernetics; Numerical Analysis; Statistics and Probability; Systems Analysis; and Theoretical Mathematics.

7.0001, SPLINE FUNCTIONS FOR APPLICATIONS

L.L. SCHUMAKER, Univ. of Texas, School of Natural Sciences, *Austin, Texas* 78712 (DF037510; AF-AFOSR-2598-74)

The design of effective and versatile aerospace vehicles require the development of new techniques for storing, in airborne computers, large amounts of data. The development of techniques for approximate representation of this data in a manner requiring less storage is very important in this respect. Such techniques can be useful in the design of effective fire control systems, navigation systems and air-to-ground missile guidance systems. An efficient way of representing data is by the use of spline functions. Such functions are becoming more and more useful in approximation of data, solution of boundary value problems, surface fitting and others. The objective of this research effort is to investigate some fundamental questions about splines which may have impact on their application to engineering problems. The research will study the zero properties of splines, constructive properties of periodic as well as discrete splines, generalized Tchebycheffian spline functions, basic approximation theory, and the application of spline functions. Spline algorithms will be developed and tested in the computer.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NM, Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

PHYSICS

Includes Physics (general); Acoustics; Atomic and Molecular Physics; Nuclear and High-energy Physics; Optics; Plasma Physics; Solid-state Physics; Thermodynamics and Statistical Physics. For Related Information See Also Engineering.

8.0001, IMAGING OF SURFACES AND DEFECTS OF CRYSTALS

J.M. COWLEY, Arizona State University, School of Liberal Arts, *Tempe, Arizona* 85281 (E(11-1)-2995)

New techniques for the study of the surface structure of crystalline solids by diffraction and imaging with electrons have been evolved by the Principal Investigator and associates. A new type of instrument has been built using an ultra-high vacuum system and allowing a combination of medium-energy (1-10keV), electron diffraction and scanning electron microscopy with a novel procedure for forming images by the use of diffracted beams. It has been shown by theoretical analysis and initial experiments that this system can give additional information, not accessible by other techniques, concerning the morphology, crystal structure and the perturbations of crystal structure by defects in very thin surface layers. Similar observations of diffraction reflection microscopy made in a conventional 100keV electron microscope have provided similar information with resolutions of 20A or better. It is proposed that the value of these techniques for the study of surfaces will be established by a series of investigations of chemical reactions at surfaces including the oxidation of metals, the reduction of oxide crystal surfaces and various interactions of graphite crystals. The techniques will be developed further in the light of the experience with these applications.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0002, GROWTH OF GALLIUM ARSENIDE

W.P. ALLRED, Crystal Specialties Inc., *Monrovia, California* 91016 (DF901130; F19628-76-C-0118)

AF function - radar communications and ECM systems which require gallium arsenide microwave devices. Deficiency - gallium arsenide microwave devices lack reliability and reproducibility due in part to the poor quality of commercially available gallium arsenide substrates. Objective - to grow improved quality gallium arsenide bulk crystals. How research contributes - this research should provide a technique to grow improved quality gallium arsenide crystals for use as substrates for gallium arsenide microwave devices. It is expected that such devices will have higher reliability and reproducibility.

The approach to this work will be divided into three areas: 1) to construct a liquid-seal Czochralski crystal puller; 2) to use the crystal puller to grow high-quality single crystals of undoped gallium arsenide using various crucible materials which will include

quartz, boron nitride, aluminum oxide, carbon, and aluminum nitride (if available). These crystals will be submitted to AFCRL/LQP for evaluation; 3) to grow single crystals of gallium arsenide which are intentionally doped with known impurities at known levels to produce n- type, p-type and semi-insulating electrical properties.

ADDENDA: Supporting agency address is: Rome Air Development Center ETS, Griffiss AFB, NY 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

8.0003, ELECTROMAGNETIC PROPERTIES OF LAYERED SUPERCONDUCTING STRUCTURES
M.R. BEASLEY, Stanford University, Graduate School, *Palo Alto, California* 94305 (DMR75-04368)

A research program will be initiated which is aimed at studying the electromagnetic properties of layered superconducting structures (layered compounds and multi-layered S/N/S thin-film composites) and at attempting to establish in detail how the layered nature of these materials affects their superconducting properties. Initial effort will be directed at sample preparation and measurements of the critical field and critical current behavior. Simple models of the observed behavior will be developed.

SUPPORTED BY U.S. Natl. Science Foundation

8.0004, THEORETICAL PHYSICS
J.D. WALECKA, Stanford University, School of Hum. & Sciences, *Palo Alto, California* 94305 (PHY75-18444 A01)

Research will be concerned with the structure of elementary particles and their interaction, the structure of nuclei using elementary particles as probes, and the quantum theory of many-body systems.

This work represents a continuation of that currently supported by Foundation grant MPS73-08916A02.

SUPPORTED BY U.S. Natl. Science Foundation

8.0005, PULSED PLASMA LOSS AND ACCELERATION MECHANISMS IN STRONG BIAS MAGNETIC FIELDS
C.L. DAILEY, Thompson Ramo Wooldridge Inc., *Redondo Beach, California* 90278 (DF044070; F44620-76-C-0107)

AF function - satellite surveillance, communication and navigation, advanced electric propulsion engines. Deficiency - insufficient fundamental understanding of loss processes and acceleration mechanisms in plasma thrusters and lack of experimental data and realistic guidelines for defining capabilities and predicting systems performance. Objective - to understand and develop theoretical and analytical models accurately describing the plasma generation, acceleration and loss phenomena associated with the biased magnetic field-electrode discharge pulsed plasma thruster concept, to obtain critical experimental data to evaluate the analytical models and the concept. How work contributes - will provide additional understanding and realistic analytical modeling of the plasma generation, acceleration and loss mechanisms in the bias field electrode thruster and will contribute to the technology base required for realistic evaluation and development of the concept as an effective simple, compact, lightweight high-thrust and total-impulse plasma space propulsion engine.

Theoretical and experimental studies will be carried out of plasma generation, acceleration and loss mechanisms associated with a quasi- steady biased magnetic field pulsed plasma thruster using an electric discharge or other means for current production. Included will be determination of plasma current distribution in the presence of the applied magnetic field and measurement of efficiency versus specific impulse delivered to the magnetic structure via thrust balance and circuit diagnostics. The acceleration performance will be examined over a range of magnetic field properties, channel shapes, electrode configurations, voltage and gas density. The energy storage and discharge modes will be examined and attempts made to optimize accelerator performance through alterations in the current discharge circuit, geometric or other parameters. Results will be used to develop a physical model describing the plasma properties, acceleration and loss mechanisms and to provide a basis for practical thruster design.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NA, Bldg 410, Bolling AFB, DC 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

8.0006, ELEMENTARY PARTICLE PHYSICS
Y. NAMBU, Univ. of Chicago, Graduate School, *Chicago, Illinois* 60637 (PHY74-08833 A02)

Research previously supported under grant GP-32904X2 will continue. Topics include: parton model, quark model, dual resonance and statistical bootstrap models, gauge theories, high-energy cross sections, and weak interactions.

SUPPORTED BY U.S. Natl. Science Foundation

8.0007, QUANTITATIVE MEASUREMENTS IN LASER-INDUCED PLASMAS USING OPTICAL PROBING
D.W. SWEENEY, Purdue University, School of Mechanical Engin., *Lafayette, Indiana* 47907 (E(11-1)-4001)

Information obtained by optically probing laser-induced plasmas can be used to provide quantitative measurements of electron density profiles, local magnetic field strengths, and plasma characteristic lengths, among others. In this investigation an analytical and numerical study will be conducted to simulate the propagation of optical probe beams through laser-induced plasmas to determine the effects of refraction, finite imaging system resolution, and plasma motion on subsequent data interpretation. Emphasis will be placed on qualitative evaluation of optical interferograms. Procedures will be developed to minimize and/or include the effects of refraction in data interpretation. The required characteristics of the probe beam, such as wavelength and temporal duration, and the required characteristics of the optical imaging system will be determined. Procedures for reconstructing the electron number density profiles from interferometric data will be investigated to determine the reconstruction resolution and accuracy that can be reasonably expected. The techniques developed will be applied to experimental interferometric data supplied by others.

Quantitative procedures will also be developed for reconstructing local magnetic fields in laser-induced plasmas using Faraday rotation measurements. The requirements for good reconstruction accuracy will be determined to evaluate the experimental practicality of quantitative reconstruction of magnetic fields.

RESULTS: Preliminary results indicate that interferometric techniques can be used to reconstruct electron densities up to 10 to the 21st power/ cubic cm in plasmas produced by 1.064 micrometer laser irradiation with a frequency quadrupled probe beam.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - L.F.D.

8.0008, THEORETICAL STUDIES OF GALLIUM ARSENIDE
J. SMILTENS, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF245690)

AF function - surveillance, reconnaissance and electronic warfare. Deficiency - lack of suitable device quality gallium arsenide material is inhibiting its exploitation in high-power microwave devices. Objective - to investigate the gallium arsenide (GaAs) phase diagram and the extent of stoichiometry of the GaAs(s) phase. How research contributes - gallium arsenide is a prime candidate material in the fabrication of solid-state high-power devices. Currently available material undergoes changes which results in the degradation of device performance. These changes in part may be due to the lack of stoichiometry in the compound material. Attempts to delineate possible methods for overcoming this problem will help in the development of experimental methods for obtaining better quality device material, thereby enhancing its use in high-power devices.

A literature review on the growth of gallium arsenide single crystals will be made with particular attention given to the factors underlying the problem of stoichiometry and suggesting ways of overcoming it.

ADDENDA: Supporting agency address is: AF Cambridge Research Laboratories LQ, L.G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

8.0009, COOPERATIVE RESEARCH IN MAGNETIC AND SUPERCONDUCTING MATERIALS
S. FONER, Mass. Inst. of Technology, Division of Sponsored Res., *Cambridge, Massachusetts* 02139 (OIP-7519584; C670 T.0. 08)

This project involves the cooperation of physicists at the Francis Bitter National Magnet Laboratory with their counterparts at the Instituto de Fisica of the Universidade de Sao Paulo. These groups will collaborate in common research projects in the general areas of magnetic phase transitions (primarily of antiferromagnets), high-field superconductors, and instrumentation. Experiments in magnetic phase transitions of antiferromagnets include: 1) determination of the phase boundaries very close to the triple point, with much higher precision than before; 2) measurements of the variation of the magnetization jump near the spin-flop transition as a function of temperature near the triple point; 3) detailed measurements of the differential magnetization near the second-order phase transitions.

The collaborative effort is largely in the area of ultrasonic properties of high-field superconductors. Exchanges and complementation of instrumentation at both locations is to take place.

This cooperative work will be carried out through frequent and intense contacts between scientists from both the U.S. and Brazilian laboratories at each other's location.

SUPPORTED BY U.S. Natl. Science Foundation

8.0010, SMALL-ANGLE X-RAY SCATTERING STUDIES
P.W. SCHMIDT, Univ. of Missouri, School of Arts & Sciences, *Columbia, Missouri* 65201 (DMR75-14071)

Small-angle X-ray scattering investigations, previously supported under GP-32528, will be continued. Approximately 80% of the effort will be devoted to X-ray studies of fluids near the liquid-vapor critical point. When a fluid is in the neighborhood of its critical point, there is a large increase in the X-ray scattering at angles no greater than a few degrees. From the extrapolated zero-angle scattered intensity, the 'reduced susceptibility' can be obtained. From the angular distribution of the scattered intensity, the long-range Xi can be calculated. The value of rho can be determined from measurements of the attenuation of the direct beam. The 'scaling function' for the scattering can be evaluated from the scattering curves. X-ray data will be obtained for argon and for one or more other fluids, such as oxygen, nitrogen, and ethylene. The second phase of the research program, which will occupy roughly 20% of the total effort, is a continuation of theoretical studies of the relationship between the scattered intensity and the form of the scattering particles in a dilute suspension of randomly oriented particles with uniform electron density. These investigations, which will be useful in the analysis of experimental scattering curves from dilute suspensions of inorganic colloidal particles, polymers, and biological macromolecules, will permit more information to be obtained from the scattering data than is now possible and will allow scattering techniques to be used in situations where these methods might not otherwise be applicable.

SUPPORTED BY U.S. Natl. Science Foundation

8.0011, STUDIES OF MAGNETIC FLUX AND CRITICAL DISTRIBUTIONS NEAR THE SURFACE IN TYPE II SUPERCONDUCTORS
R.W. ROLLINS, Ohio University, School of Arts & Sciences, *Athens, Ohio* 45701 (DF040610; AF-AFOSR-2807-75)

AF function - the proposed research primarily falls in the 5.3 research objectives which deals with electrical power from nonnuclear energy sources. In particular, the development of superconductive rotating electrical power generators and pulsed superconductive energy storage systems requires basic understanding of magnetic flux motion and associated losses in type II superconductors. Knowledge of magnetic flux pinning sites and their influence on losses is needed. Deficiency - losses incurred during ac operation are one of the major problems encountered in the development of AF high-power superconducting devices. Such ac power losses often arise entirely from a small region near the surface of the superconducting material where local inhomogeneities give rise to pinning of the magnetic flux. Objective - the objective of this research is to develop an understanding of pinning mechanisms and surface preparation together with their effect on the magnetic flux distributions near the surface of a superconductor. Specifically, critical currents and flux pinning due to defects produced by bombardment of ions of controlled energy will be studied. How work contributes - this research is a part of a comprehensive program in superfluids and superconductors.

It is planned to continue according to the proposal studying the effect of proton irradiation on pure Nb, Nb-Ta and Nb-Ti alloys, including in particular the relationship between the superconducting properties and flux pinning and (1) the total proton fluence, (2) the effect of low-temperature anneals (100-800 degrees C) on the irradiated samples, (3) the energy of the incident protons. Measurements of the flux pinning force, fv, will be made as a function of magnetic field and temperature. The behavior of the peak observed in fv for irradiated Nb will be carefully studied and we will look for similar peaks which may occur in irradiated Nb alloys. Recent work strongly suggests that the defects responsible for the flux pinning in room-temperature neutron- irradiated Nb are dislocation loops. Similar defects are expected to be formed by proton irradiation. Comparing neutron and proton irradiation for the same energy and dose, protons are from 10-1000 times more effective in producing displaced atoms which lead to the dislocation loops. (Text Abridged.)

SUPPORTED BY U.S. Dept. of Defense - Air Force

8.0012, DENSITY-FUNCTIONAL THEORY FOR NON-UNIFORM MANY-BODY SYSTEMS
W.F. SAAM, Ohio State University, School of Math. & Phys. Scis., *Columbus, Ohio* 43210 (DMR75-21866)

This project encompasses two major areas of theoretical study. Both involve the development and application of density-functional (DF) theory for non-uniform many-body systems. These are: Extension of the recently developed DF theory for T equals O liquid He4 treated thin films and the electron bubble state; Further investigation and refinement of preliminary work of these investigators on a DF theory for classical Lennard-Jones systems and application of this theory to the cases of thin films, nucleation, self-trapped electron states in dense gases, and the liquid-solid phase transition.

SUPPORTED BY U.S. Natl. Science Foundation

8.0013, NONEQUILIBRIUM PHENOMENA IN SUPERCONDUCTORS
D.N. LANGENBERG, Univ. of Pennsylvania, School of Arts & Sciences, *Philadelphia, Pennsylvania* 19104 (DMR73-02484 A01)

Experimental and theoretical investigations of nonequilibrium phenomena in superconductors supported by NSF Grant DMR-7302484 will be continued. Particular emphasis will be placed on the determination of the intrinsic quasiparticle recombination time in a variety of superconductors, the study of the quasiparticle and phonon distributions in the nonequilibrium state, and the elucidation of the 'photon-induced intermediate state' which has been previously observed.

SUPPORTED BY U.S. Natl. Science Foundation

8.0014, THEORETICAL PHYSICS
L.S. KISSLINGER, Carnegie Mellon University, Graduate School, *Pittsburgh, Pennsylvania* 15213 (PHY75-22555 A01)

Theoretical research in nuclear physics initiated under NSF grant MPS73-05010A01 will be continued. Specific topics to be investigated include: 1. Nuclear structures at high and low spin (Sorensen); 2. Equation of motion method for 28 less than z less than 50 nuclei (Kisslinger); 3. Pion-nucleus elastic scattering and reactions. Multiple scattering theory (Kisslinger); 4. Doorway-isobar model (Kisslinger); 5. Baryon resonance components of nuclei (Kisslinger); 6. The (K negative, negative pion) reactions on nuclei (Kisslinger); 7. Spectroscopic factors from analytic properties (Kisslinger).

SUPPORTED BY U.S. Natl. Science Foundation

8.0015, ELEMENTARY PARTICLE PHYSICS USING HIGH-ENERGY ACCELERATORS
R.W. WILLIAMS, Univ. of Washington, School of Arts & Sciences, *Seattle, Washington* 98105 (PHY76-18595)

The University of Washington's High-Energy Physics Laboratory is involved in several experiments at Fermilab. 1. A study of hadronic interactions in which at least one particle is emitted with high transverse momentum (E-236A). A double arm system consisting of a large aperture magnet spectrometer on one side and a segmented calorimeter on the other will be used to address questions of single particles and jets of particles from events characterized by high transverse momentum. 2. A study of the dissociation of pions diffractively scattered from helium in a streamer chamber (E-86). 3. A search for massive particle states which decay into muon pairs (E-439). 4. A search with the missing mass technique of states whose decay products contain, among other particles, one or more muons (E-411 and E-413).

This work is a continuation of that currently supported by Foundation grant PHY70-01924A08.

SUPPORTED BY U.S. Natl. Science Foundation

SPACE SCIENCES

Includes Space Sciences (general); Astronomy; Astrophysics; Lunar and Planetary Exploration; Solar Physics; and Space Radiation. For Related Information See Also Geosciences.

10.0001, SOLAR 7000 MHZ POLARIZATION PATROL AND HIGH-RESOLUTION OBSERVATIONS
D.P. MARQUES, Univ. Mackenzie, *Sao Paulo, Brazil* (DF276440; AF-AFOSR-2230-72)

AF function - solar and ionospheric forecasting. Deficiency - relationship between cause (solar disturbance and related emissions) and effects (ionospheric changes) which adversely affect communications is not understood. Objective - to establish correlations between cause and effect to better predict geophysical events. How research contributes - the key in solar disturbances is the magnetic field at burst heights. Polarization measurements and especially polarization spectral data can indicate the magnetic field strength and thus aid in the interpretation of events. This interpretation must precede forecasting.

For radio bursts, measurements of the degree of circular polarization will be evaluated in relation to theoretical models to identify mechanisms and to improve models. High-resolution observations of active regions in their pre-flare phase will be made, increases in intensity or polarization can indicate changes in the magnetic field in these regions.

Addenda: Supporting agency address is: AF Geophysics Laboratory PH, L.G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

10.0002, CHROMOSPHERIC STRUCTURES
H. ZIRIN, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (DF240610; F19628-76-C-0055)

AF function - communications, surveillance, detection, tracking. Deficiency - inadequate warnings of sun-induced disruptions. Objective -determine the effect of chromospheric structures, motions and magnetic fields on the solar atmosphere and how each contributes to the environment for solar activity. How research contributes - provide the physical knowledge necessary for a sound cause-and-effect prediction technique for solar-induced disruptions.

Collaborative studies with the Sacramento Peak Observatory on the chromosphere to obtain maximum observational data on selected solar events.

ADDENDA: Supporting agency address information: AF Cambridge Research Laboratories LM, L.G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

10.0003, OBSERVATION AND INTERPRETATION OF COSMIC-RAY MODULATION EVENTS AT HIGH ENERGIES
R.L. CHASSON, Univ. of Denver, School of Arts & Sciences, *Denver, Colorado* 80210 (ATM75-22875)

This grant supports the operation of the University of Denver's cosmic-ray monitors and the analysis and interpretation of the data, including 8 years of high-quality data already acquired, in terms of galactic, solar, and interplanetary effects. The University of Denver's cosmic-ray monitor is a large-array muon detector (10-50 GeV), one of the few in the Western Hemisphere. Muon detectors bridge the gap in the energy spectrum between neutron monitors (1-10 GeV) and underground detectors (greater than 50 GeV). They will investigate the interpretation of solar and sidereal variations in terms of local and galactic influences, and will study short-term variations with a view to further understanding solar-terrestrial relations.

SUPPORTED BY U.S. Natl. Science Foundation

10.0004, NAVY ENVIRONMENT - THE DEVELOPMENT OF BETTER FORECASTING TECHNIQUES FOR NAVAL OPERATIONS
R. REITER, Physical Bioclimatic Res. Inst, *Garmisch Partenkirchen, Federal Republic of Germany* (DN223410; N00014-72-C-0287)

A study of the earth's responses of atmosphere to solar transient events is the objective of this research. The time lag between the solar event and atmosphere is expected to be of predictive value for Navy weather forecasts.

An apparent atmospheric response already observed, viz, influx of stratospheric air into the troposphere and variation of atmospheric electric parameters, will be further studied for possible correlations with solar h alpha and X-ray flares, sunspot numbers, calcium plage indices, solar corona, solar X-ray intensity, solar fluxes between 1,000 and 10,000 mHz, solar wind, radio propagation index, geomagnetic indices, and magnetic field sector passages.

ADDENDA: Supporting agency address is: Office of Naval Research Arlington, VA 22217. Performing organization: Physikalisch-Bioklimatche Forschungsstelle.

SUPPORTED BY U.S. Dept. of Defense - Navy

10.0005, SOLAR RADIO BURST AND PATROL DATA STUDIES APPLIED TO SPACE ENVIRONMENT
J.P. CASTELLI, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF274870)

AF function - communications and surveillance. Deficiency - there is a need to identify spurious signals in surveillance systems as man- made or natural phenomena. Forecasts of solar geophysical events which disturb the ionosphere have been unreliable and inadequate. Research - maintain a real-time multifrequency solar radio patrol with moderate to low angular resolution at Sagamore Hill between 24 and 35000 mHz for operational usefulness in providing data alerts. Assist in completion of AF solar radio network. Develop correlations (identify signatures) between solar radio and geophysical phenomena to forecast proton events. Develop automation and specialized equipment to satisfy operational needs. How research contributes - radio emission is a prime indicator of the status of solar activity and the degree to which AF systems operating in the near space environment are likely to be affected. Forecast techniques are being developed from solar radio burst signatures.

The characteristics of bursts are being studied to develop a technique for the early identification of proton flare regions. The radio burst characteristics of lesser proton regions are emerging. Different parts of the burst spectrum show promise in prediction of electron and proton energy distribution. Correlations are being performed with EUV and X-rays for prediction of ionospheric disturbances which disrupt communication. Ground-based solar radio data are quantitative, available in real time. The radio signatures of solar disturbances often provide the first reliable information on the importance of an event and allow for warning of subsequent related effects. This data base is being used for specifying the neutral atmospheric density--relevant in satellite 'drag' considerations.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LI, L.G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

10.0006, SOLAR PARTICLE OBSERVATION
G.K. YATES, U.S. Air Force, Cambridge Research Labs., *Bedford, Massachusetts* (DF241500)

AF function - communications and effects on satellite and missile operations. Deficiency - unable to accurately predict solar particle effects on atmospheric and ionospheric environmental conditions. Research - data acquisition and analysis required for implementation of forecasting techniques. Objective - in FY75 analysis of AF satellite OV5-6 will continue in order to add to and broaden the data base for planning SOLRAD-HI satellite operations, and either to establish or to deny the existence of a possible correlation between DSCS anomalies and solar flux enhancements. The integration of SOLRAD-HI will commence. Routines will be developed and tested for the real-time data analyses and event identification for AFGWC operational use of the SOLRAD-HI data. How research contributes - will provide solar particle data required for definition of aerospace environment; is concerned with providing data needed to define and predict the effect of solar particle-induced ionospheric changes that affect AF systems. In addition to providing data to environmental forecasters, data will be analyzed to identify critical parameters required to improve the definition of the aerospace environment and the effects of solar radiation on it. Energetic particles accelerated at the sun propagate through the interplanetary medium, impinge on the atmosphere and significantly affect the e.m. propagation via the ionosphere. Current knowledge and prediction techniques are insufficient to accurately predict solar particle outbursts and their effects on the aerospace environment; therefore, routine systematic measurements of solar particles, rapid data processing techniques and dissemination of critical parameters to forecasting personnel are essential.

This unit provides solar particle data that will assist in the definition of the aerospace environment. It is concerned with the provision of data needed to define and predict the effect of solar particle-induced ionospheric changes that affect AF systems. In addition to providing data to environmental forecasters, data will be analyzed to identify critical parameters required to improve the definition of the aerospace environment and the effects of solar radiation on it. Energetic particles accelerated at the sun propagate through the interplanetary medium, impinge on the atmosphere and space vehicles, and significantly affect the e.m. propagation via the ionosphere and satellite operations. (Text Abridged.)

SUPPORTED BY U.S. Dept. of Defense - Air Force

10.0007, HIGH-RESOLUTION INTERFEROMETRY OF THE SUN AT 3.7 CM AND 11 CM WAVELENGTHS
K.R. LANG, Tufts University, School of Arts & Sciences, *Medford, Massachusetts* 02155 (DF245990; F19628-76-C-0020)

AF function - communications and navigation. Deficiency - medium- range (1 to 7 days) and short-range (min. to 1 day) capability for advance and reliable predictions of operationally disruptive solar activity. Objective - to detect signatures in active region radio emissions that provide advance warning of solar activity. How research contributes - provides a knowledge of active regions necessary to establish operational forecast techniques that allow advance warning of electromagnetic and particle emissions that disrupt HF communications, OTH radars, and satellite sensors.

High-resolution interferometric observations (with a resolution of near 7 arc seconds) will be made at the NRAO. Observatory to find signatures in radio emission prior to flares. The sharp resolution of this radiotelescope will allow the hot pinpoint sources, thought to be flare triggers, to be accurately located in the active region, and by observing at 3.7 and 11 cm wavelengths to estimate the 'altitude' of the disturbance. These spatial parameters will be combined with complete Stokes polarization parameters and temporal variations to seek an accurate description of the possible flare triggers and to assess their role as operational tools for forecasting solar activity.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory PH, L.G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

10.0008, STUDIES IN ADVANCED STELLAR EVOLUTION
M. SCHWARZSCHILD, Princeton University, Graduate School, *Princeton, New Jersey* 08540 (AST75-22924 A01)

Theoretical and numerical studies will be made of late stages in the life cycle of a star. Stars in an advanced stage of evolution are subjected to complex nuclear reactions and violent dynamical instabilities. Many appear to be surrounded by extended envelopes dominated by strong turbulent convection. Schwarzschild and co-workers have discovered a new thermal instability of the outer-most layers of the giant envelope surrounding some aging stars. This envelope contains the hydrogen ionization zone. The main effort in this research will be to study the character and consequences of this new instability on the aging process of the associated star.

This is a continuation of work previously supported by NSF grant AST 75-22924.

SUPPORTED BY U.S. Natl. Science Foundation

10.0009, NAVIGATION - DUDLEY OBSERVATORY 100-FOOT PARABOLIC ANTENNA
J.W. ERKES, Dudley Observatory, *Albany, New York* 12208 (DN223028; N00014-72-C-0040)

This work unit will produce new and accurate data on the position of interstellar objects and should prove useful for navigation.

Distributions of hydrogen around supernova remnants will be observed to refine knowledge of expansion velocities and distance. Flux density variations in quasars will be monitored. Interstellar dust and molecule distributions will be determined and compared.

ADDENDA: Supporting agency address is: Office of Naval Research 427, Arlington, VA. 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

10.0010, THE BINARY STAR SYSTEM BETA SCORPII A
J.L. ELLIOT, Cornell University, Center For Radioph. & Sp. Res., *Ithaca, New York* 14850 (AST76-14832)

Stellar masses and absolute magnitudes obtained from observational data establish the empirical mass-luminosity relation and can be used to check models of stellar structure and evolution. For stars of spectral type B2 and earlier, few reliable masses are available, and the calibration of this region of the mass-luminosity diagram is uncertain. Further study of the spectroscopic binary Beta Scorpii A (BOV, B2V) may result in the precise determination of its parallax, which will yield the masses and absolute magnitudes of its members. The separation of the binary components and their angular diameters have been recently determined from light curves obtained when Beta Scorpii A was occulted by Jupiter and the moon. Combined with parameters of the spectroscopic orbit, these data suggest that Beta Scorpii A may exhibit shallow eclipses, allowing its distance to be determined. Photometric observations of Beta Scorpii A obtained at Kitt Peak during May 1975 will be analyzed in search of shallow eclipses that would establish the masses and absolute magnitudes of the members of this binary system.

SUPPORTED BY U.S. Natl. Science Foundation

10.0011, THEORETICAL SOLAR SYSTEM STUDIES
T. GOLD, Cornell University, School of Physical Sciences, *Ithaca, New York* 14850 (AST74-17838 A02)

Theoretical discussion of several solar system problems will be undertaken, including: 1. The dynamical reasons why certain classes of satellite and asteroid orbits are preferentially populated in the solar system. 2. The drag exerted by a plasma and the magnetic field of a magnetosphere upon a charged grain, and its relevance to the rings of Saturn. 3. Interchange of the atmosphere of a satellite with a gaseous ring of material surrounding the parent planet, as found in the Jupiter system. 4. Further development of the theory of the process of differential evaporation of the different ions from the atmosphere of the sun - the solar corona - and its effect on the solar wind. 5. Applications of solid-state work and statistical physics, which continues work already in progress, on (a) thermal models for the interior of Jupiter, (b)

gravitational layering and fluid dynamics within Jupiter, (c) droplet formation at interior levels of Jupiter, also (d) grain-grain collisions and sputtering as related to the accumulation process, and its rate, in the early solar nebula.

Prior support was by NSF grant AST 74-17838.

SUPPORTED BY U.S. Natl. Science Foundation

10.0012, ANALYSIS OF SOLAR RADIO BURST SPECTRA USING GYROSYNCHROTRON THEORY & ITS RELATION TO SOLAR BURSTS

H.C. KO, Ohio State University, School of Engineering, *Columbus, Ohio* 43212 (DF259250; F19628-76-C-0108)

AF function - solar and space forecasting. Deficiency - inadequate understanding of burst conditions and processes hinders the development of new techniques to forecast the terrestrial disturbances caused by solar bursts. Objective - to gain a better understanding of solar burst- region parameters and emission mechanisms. How research contributes - theoretically derived results will be used to analyze burst data to improve our understanding of what is taking place.

Burst radio spectral data will be compared with theoretical spectral models generated from numerical calculations based on gyrosynchrotron emission theory. From comparisons and further analyses, increased knowledge of how burst-region properties relate to the radio spectral characteristics of bursts will be obtained. This knowledge will lead to improved techniques for using radio spectral signatures to forecast burst effects.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory PH, L.G. Hanscom AFB, Bedford, Mass 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

10.0013, THEORETICAL ASTROPHYSICS

D.D. CLAYTON, Rice University, Graduate School, *Houston, Texas* 77001 (AST74-20076 A02)

'Theoretical Astrophysics' as these researchers practice it is primarily the attempt to use discoveries of physics and chemistry in providing new explanations and new predictions of astronomical events. Their research therefore emphasizes new ideas. Associated with this, however, is a degree of 'model building' -- the application of physical laws and computer programming to construct working models of astronomical events to be compared to observations. This current proposal identifies specific work plans in the following areas: (1) the structure of stars as they evolve from birth until death, largely by computer models; (2) the effect of star evolution on the observed features of galaxies; (3) origin of the elements; (4) analysis of the puzzling lack of detected neutrinos from the sun by the Brookhaven Solar Neutrino Laboratory; (5) study the possible existence of black holes in the interiors of stars; (6) the appearance and fate of stars so massive that they are not stable; (7) nuclear explosions and creation of new elements in matter that has fallen onto the surface of dense white-dwarf stars; (8) models of what a nova explosion should look like after the explosion, in visible light, in infrared, and in gamma radiation; (9) the meaning of the existence of the strange CH sub-giant stars; (10) formation of dust particles in gas cooling after ejection from a star, nova, or supernova; (11) current creation of elements in stars by capture of neutrons -- a cosmic breeder reactor; (12) origin and evolution of the solar system; (13) interpretation of anomalous minerals and noble gases found in meteorites; (14) drift of dust into the solar system; and (15) expectations of new knowledge from nuclear-gamma-ray astronomy. This theoretical work touches on an extremely wide range of specialized topics in observational astronomy, but the theoretical perspective provides a framework for relating topics which otherwise appear to be independent.

This is a continuation of work previously supported by NSF grant AST 75-19749.

SUPPORTED BY U.S. Natl. Science Foundation

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N77-14980* + National Aeronautics and Space Administration, Washington, D.C.
AERONAUTICAL ENGINEERING: A SPECIAL BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 75, OCTOBER 1976
Oct. 1976 117 p
(NASA-SP-7037(75)) Avail: NTIS HC E02 CSCL 01A

This bibliography lists 300 reports, articles, and other documents introduced into the NASA scientific and technical information system in September 1976. Author

N77-14981*# Hudson Inst., Inc., Croton-on-Hudson, N.Y.
DOMESTIC AND WORLD TRENDS (1980 - 2000) AFFECTING THE FUTURE OF AVIATION Final Report
Norman Friedman, William Overholt, John Thomas, and Anthony J. Wiener 1 Aug. 1975 104 p
(Contract NAS5-20852)
(NASA-CR-144838; HI-2210/3-RR) Avail: NTIS HC A05/MF A01 CSCL 01B

Variables affecting aviation in the United States during the last fifth of the twentieth century are studied. Estimates of relevant future developments are presented and their probable impact on the aviation industry in this country are identified. A series of key trends relating to economic, social, political, technological, ecological and environmental developments are identified and discussed with relation to their possible effects on aviation. From this analysis, a series of scenarios are developed representing an array of possibilities ranging from severe economic depression and high international tension on the one hand, to a world of detente which enjoys an unprecedented economic growth rate and relaxation of tensions on the other. A surprise free scenario is presented which represents the best judgment of the manner in which events will most probably develop and the effect on the aviation industry such developments will likely produce. Author

N77-14982# Advisory Group for Aerospace Research and Development, Paris (France).
ELEVENTH AGARD ANNUAL MEETING
Feb. 1976 70 p refs Meeting held at Ottawa, 18 Sep. 1975
(AD-A023909; ISBN-92-835-1212-X) Avail: NTIS HC A04/MF A01

An investigation of aerospace research and development emphasizing the area of short takeoff (STOL) aircraft in Canada was presented. Research into the military air material requirements and the governmental support given was discussed. The government policies concerning research into STOL aircraft and its military as well as commercial possibilities were studied. Military application of the TEA-CO2 laser was considered, including radar type applications and use of the laser as a weapon. For individual titles, see N77-14983 through N77-14988.

N77-14983# Department of National Defence, Ottawa (Ontario).
CANADIAN MILITARY AIR MATERIEL REQUIREMENTS
D. W. Goss *In* AGARD 11th AGARD Ann. Meeting Feb. 1976 p 11-14 (For primary document see N77-14982 06-01)
Avail: NTIS HC A04/MF A01

Cold and snow are but two characteristics of Canada which must be accounted for in stating military requirements. The northern magnetic pole is in Canada, and aurora borealis displays are frequent, affecting communications and navigation. When winter's grip relaxes, the insect population emerges making life barely livable without some form of protection. Most of these characteristics must be catered to in stating requirements for material, as they affect all facets of equipment performance, from aircraft range through special navigation requirements through special environmental protection requirements. In addition to purely Canadian conditions, the conditions related to operations in Europe and the material requirements are superimposed. Among these are the extremely corrosive atmosphere which proved particularly troublesome, and less tangible but equally serious differences in the stresses due to a difference in the turbulence regime, differences in bird hazards and so on. As some of the forces are also assigned to the United Nations in the Middle East, conditions of heat, sand and corrosive atmosphere must also be considered in this application of our equipment in this environment. Author

N77-14984# Department of National Defence, Ottawa (Ontario).
RESEARCH AND DEVELOPMENT IN SUPPORT OF CANADIAN MILITARY AIR REQUIREMENTS
E. J. Bobyn *In* AGARD 11th AGARD Ann. Meeting Feb. 1976 p 15-18 (For primary document see N77-14982 06-01)
Avail: NTIS HC A04/MF A01

The Department of National Defense in cooperation with other government departments and industry initiated V/STOL aircraft research and development. The bulk of the research and development activity was directed towards sub-systems, acquisition of technical knowledge, human factors in man/machine interface, avionics, systems analysis, surveillance, propulsion devices, landing gear, detection devices, navigation aids, data processors, materials, power supplies, weapon modifications, and other associated components. Author

N77-14985# National Research Council of Canada, Ottawa (Ontario).
CANADIAN RESEARCH AND DEVELOPMENT POLICIES **c81**
J. D. Keys *In* AGARD 11th AGARD Ann. Meeting Feb. 1976 p 19-21 (For primary document see N77-14982 06-01)
Avail: NTIS HC A04/MF A01

There is no single science policy suitable for Canada. Instead, it is accepted that the federal government's science policy is the sum of three distinct areas: (1) policies for support of science; (2) policies for application of science and technology; and (3) science as a component of public policy. Author

N77-14986# De Havilland Aircraft Co. of Canada Ltd., Ottawa (Ontario).
STOL DEVELOPMENTS **c02**
J. P. Uffen *In* AGARD 11th AGARD Ann. Meeting Feb. 1976 p 22-41 refs (For primary document see N77-14982 06-01)

Avail: NTIS HC A04/MF A01

The characteristics of STOL aircraft which distinguish them from conventional, CTOL, aircraft are described. Examples of the way in which STOL has evolved are given, with discussion of the features of the de Havilland Dash 7. Looking to the future, developments which retain the short takeoff and landing capability while extending the speed, payload and range of STOL aircraft are described. These have differing characteristics, which permit selection of optional configurations for particular roles. Author

N77-14987# Canadian Air Transportation Administration, Ottawa.
OVERVIEW OF THE CANADIAN MINISTRY OF TRANSPORT'S STOL DEMONSTRATION c03
F. C. Black *In* AGARD 11th AGARD Ann. Meeting Feb. 1976 p 42-44 (For primary document see N77-14982 06-01)
Avail: NTIS HC A04/MF A01

AIRTRANSIT Canada operates six modified Twin Otter aircraft leased from the Ministry of Transport on a high frequency STOL commuter service between Ottawa and Montreal. The aircraft are operated from convenient STOLports, located close to the central business districts of each city. The aircraft and STOLports are designed to permit scheduled instrument operations using steep gradient approaches on a microwave scanning beam landing guidance system, the first of its kind in commercial service today. In addition, each aircraft is equipped with a three dimensional area navigation system used in conjunction with specially developed control procedures permitting operations in high density terminal areas without active direction on the part of air traffic control. Each aircraft carries a data acquisition system that records information to be used as a data base for the development of future STOL regulations and operating criteria in Canada. Passenger processing was streamlined through the use of STOLmobiles and abbreviated ticketing methods. Reservations are held up to five minutes prior to departure. From the time a passenger disembarks the aircraft at the Montreal STOLport until he arrives in the downtown area averages between 10 and 15 minutes. Author

N77-14988# Defence Research Establishment Valcartier (Quebec).
TRANSVERSELY EXCITED ATMOSPHERE (TEA): CO2 LASER DEVELOPMENT AND APPLICATIONS c36
J. Gilbert *In* AGARD 11th AGARD Ann. Meeting Feb. 1976 p 45-57 (For primary document see N77-14982 06-01)
Avail: NTIS HC A04/MF A01

Military applications of the TEA-CO2 laser are considered. These are of two main types: radar type applications, and use of the laser as a weapon. In radar we are dealing with relatively low energy transmission over a two way path; in the case of the weapon, high energy is transmitted over a one way path. The factors which must be taken into account in assessing the feasibility of using a laser in a military system are: atmospheric propagation, target characteristics, laser technology, detection technology and, as systems become more sophisticated, countermeasures. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N77-14989 Arizona Univ., Tucson.
VORTICITY-ORIENTED ANALYSIS OF VISCOUS UNSTEADY FLOW OVER A TWO-DIMENSIONAL AIRFOIL Ph.D. Thesis
Zygmunt M. Cielak 1976 219 p
Avail: Univ. Microfilms Order No. 76-28203

A numerical algorithm is presented for solving the two dimensional, unsteady, constant property flow over an airfoil started impulsively from rest in a viscous fluid. The algorithm, called here the Vorticity Source Model, is based on the concept of vorticity production at the solid surface, followed by vorticity dispersion in the fluid by convection and viscous diffusion. The main task of the numerical procedure is to compute the vorticity production at the solid surface. The airfoil surface is replaced by vortex singularities (called the bound vorticity). By imposing the condition that there can be no flow across the solid surface, an integral equation governing the vortex distribution is derived using techniques which carry over the potential-flow theory. The integral equation is solved numerically in a straightforward fashion, and the solution is made unique by requiring that the total vorticity remain zero for all time. Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-14990 Yale Univ., New Haven, Conn.
UNSTEADY SUPERSONIC FLOW WITH HEAT ADDITION DUE TO CONDENSATION Ph.D. Thesis
Francis Pierre Mosnier 1976 144 p
Avail: Univ. Microfilms Order No. 76-29206

The experimental work focuses on the influence of the ratio of the specific heats of the carrier gas, the dimensionless latent heat, and the Damkohler number on the dimensionless frequency of the fluctuating flow. The investigation is carried out in a Ludwieg tube, taking advantage of the increase of supply relative humidity with constant specific humidity over three flow periods. Pressure measurements made with piezoelectric pressure transducers at different sections in the nozzle provide information about the amplitude and frequency of the oscillations as well as the mean pressure distribution. The dimensionless heat addition parameter does not have a strong influence on the flow. The influence of the Damkohler parameter is not clear yet due to the small difference in characteristic condensation times between water and ethanol. Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-14991 Cincinnati Univ., Ohio.
PREDICTION OF TRANSONIC INVISCID STEADY FLOW IN CASCADES BY FINITE ELEMENT METHODS Ph.D. Thesis
Timothy Chandler Prince 1976 114 p
Avail: Univ. Microfilms Order No. 76-28343

The finite element method is applied to the prediction of transonic flow on a blade-to-blade surface of revolution in a turbomachine. The continuity equation for steady potential flow is solved using the Rayleigh-Ritz-Galerkin variational method. A given stream and blade channel is divided into simple triangular prism elements. The nonlinear Galerkin system of equations which corresponds to the continuity equation is constructed. This system is solved directly when the flow is not choked. When the flow is choked, the boundary conditions for potential flow overdetermine the solution, but a sufficiently accurate least square solution is obtained. The nonlinear system of equations is solved by the Newton-Raphson method. While the resulting linear systems are theoretically positive definite, numerical calculations do not always preserve this quality. Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-14992 Engineering Sciences Data Unit, London (England).
AERODYNAMIC CENTRE OF WING-FUSELAGE COMBINATIONS
Sep. 1976 17 p
(ESDU-76015; ISBN-0-85679-151-2) For information on availability of series, sub-series and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161. HC $242.50

Data for estimating the aerodynamic center of wing fuselage combinations to aid in aircraft stability calculations are presented. ESDU

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-14993 Georgia Inst. of Tech., Atlanta.
THEORETICAL ANALYSIS OF UNSTEADY SUPERSONIC FLOW AROUND HARMONICALLY OSCILLATING TURBOFAN CASCADES Ph.D. Thesis
John Everett Caruthers 1976 157 p
Avail: Univ. Microfilms Order No. 76-29354

A solution method is developed for the supersonic cascade problem utilizing a finite difference/pressure-amplitude-function technique. The method developed is valid for both the supersonic and subsonic leading edge problems, although developed specifically for the latter problem. Excellent agreement is obtained with existing solutions in all the limiting cases, and the cascade results are compared with some recently published results using other methods. A parametric study is given of a typical supersonic cascade configuration. Dissert. Abstr.

DATA SUMMARY: Data summary not prepared due to nonavailability of complete document for processing.

N77-14994 Michigan Univ., Ann Arbor.
UNSTEADY TRANSONIC FLOWS WITH SHOCK WAVES IN AN ASYMMETRIC CHANNEL Ph.D. Thesis
John Shiu-kam Chan 1976 129 p
Avail: Univ. Microfilms Order No. 76-27462

Two-dimensional, inviscid, unsteady transonic flows with shock waves in an asymmetric channel were investigated using the method of matched asymptotic expansions. The dimensionless radius of curvature of the channel was of order E to the -1 power, where E is a small parameter measuring the deviation of the flow from the sonic speed. The unsteady flows considered were those in which the characteristic time associated with the imposed disturbances is much greater than the time required for a sonic disturbance to cross the transonic region in the flow direction. The direct method of solution was then employed using an asymptotic expansion in terms of E for the velocity potential. The results are applicable to flows in jet engine inlets and between the blades of turbomachinery. Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-14995*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASA AMES THREE-DIMENSIONAL POTENTIAL FLOW ANALYSES SYSTEM (POTFAN) BOUNDARY CONDITION CODE (BCDN), VERSION 1
J. E. Davis (Computer Sciences Corp., Mountain View, Calif.) and R. T. Medan Jan. 1977 53 p refs
(NASA-TM-X-73187) Avail: NTIS HC A04/MF A01 CSCL 01A

This segment of the POTFAN system is used to generate right hand sides (boundary conditions) of the system of equations associated with the flow field under consideration. These specified flow boundary conditions are encountered in the oblique derivative boundary value problem (boundary value problem of the third kind) and contain the Neumann boundary condition as a special case. Arbitrary angle of attack and/or sideslip and/or rotation rates may be specified, as well as an arbitrary, nonuniform external flow field and the influence of prescribed singularity distributions. Author

DATA SUMMARY: No numeric data are presented.

N77-14996*# Boeing Co., Renton, Wash.
TEST DATA REPORT: LOW SPEED WIND TUNNEL TESTS OF A FULL SCALE, FIXED GEOMETRY INLET, WITH ENGINE, AT HIGH ANGLES OF ATTACK
W. M. Shain Nov. 1976 119 p refs
(Contract NAS2-9215)
(NASA-CR-151927; T6-6094) Avail: NTIS HC A06/MF A01 CSCL 01A

A full scale inlet test was to be done in the NASA-ARC 40' X 80' WT to demonstrate satisfactory inlet performance at high angles of attack. The inlet was designed to match a Hamilton-Standard 55 inch, variable pitch fan, driven by a Lycoming T55-L-11A gas generator. The test was installed in the wind tunnel on two separate occasions, but mechanical failures in the fan drive gear box early in each period terminated testing. A detailed description is included of the Model, installation, instrumentation and data reduction procedures. Author

DATA SUMMARY: Diverse data are presented; variables include angle of attack, nozzle temperature, inlet temperature, core dynamic pressure, fan blade angle, engine exhaust gas temperature, fan cowl temperature, fan face dynamic pressure, tunnel velocity.

N77-14997# Advisory Group for Aerospace Research and Development, Paris (France).
STATE-OF-THE-ART IN UNSTEADY AERODYNAMICS
William P. Rodden Nov. 1976 12 p refs Presented at the 43d Structures and Materials Panel Meeting, London, Sep. 1976
(AGARD-R-650; ISBN-92-835-1230-9) Avail: NTIS HC A02/MF A01

A brief survey of new developments in unsteady aerodynamics is made as a proposal for establishing another comparative computational AGARD program. Candidate topics include supersonic interference, transonic flow, wing-body interference, control surfaces, rotary loads on T-tails, interference effects of vortex shedding, and rotating blades. A selected bibliography is presented for each topic to illustrate the present state-of-the-art and its near term future potential. Author

DATA SUMMARY: No numeric data are presented.

N77-14998*# Cornell Univ., Ithaca, N.Y.
SOME EXPERIMENTS IN SWIRLING FLOWS: DETAILED VELOCITY MEASUREMENTS OF A VORTEX BREAKDOWN USING A LASER DOPPLER ANEMOMETER Ph.D. Thesis - Cornell Univ. Final Report
James Henry Faler Sep. 1976 216 p refs
(Grant NsG-3019)
(NASA-CR-135115) Avail: NTIS HC A10/MF A01 CSCL 01A

The results of an experimental study of spiraling flows in a slightly diverging, circular duct are reported. Seven types of flow disturbances were observed. In addition to the spiral and axisymmetric vortex breakdowns and the double helix mode, four other forms were identified and are reported. The type and axial location of the disturbance depended on the Reynolds and circulation numbers of the flow. Detailed velocity measurements were made by using a laser Doppler anemometer. Measurements made far upstream of any disturbance showed that the introduction of swirl resulted in the formation of a high axial velocity jet centered around the vortex center. A mapping of the velocity field of a so-called axisymmetric breakdown, formed at a Reynolds number of 2560, revealed that the recirculation zone is a two-celled structure, with four stagnation points on the vortex axis marking the axial extremes of the concentric cells. The dominant feature of the flow inside the bubble was the strong, periodic velocity fluctuations. Existing theoretical models do not predict the two-celled structure and the temporal velocity fluctuations that were observed. Author

DATA SUMMARY: Detailed velocity measurements of the vortex breakdown flow field; variables include Reynolds number, axial velocity, swirl velocity, time, nondimensional radius, axial distance upstream of bubble nose, radial location, axial distance downstream of bubble nose, power spectra, frequency; 35 figures and 11 tables include numeric data.

N77-14999*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TWO-DIMENSIONAL AERODYNAMIC CHARACTERISTICS OF SEVERAL ROTORCRAFT AIRFOILS AT MACH NUMBERS FROM 0.35 TO 0.90
Kevin W. Noonan (Army Air Mobility Res. and Develop. Lab., Hampton, Va.) and Gene J. Bingham (Army Air Mobility Res. and Develop. Lab., Hampton, Va.) Jan. 1977 52 p refs
(NASA-TM-X-73990) Avail: NTIS HC A04/MF A01 CSCL 01A

An investigation was conducted in the Langley 6- by 28-inch transonic tunnel and the 6- by 19-inch transonic tunnel to determine the two-dimensional aerodynamic characteristics of several rotorcraft airfoils at Mach numbers from 0.35 to 0.90.

The airfoils differed in thickness, thickness distribution, and camber. The FX69-H-098, the BHC-540, and the NACA 0012 airfoils were investigated in the 6- by 28-inch tunnel at Reynolds numbers (based on chord) from about 4.7 to 9.3 million at the lowest and highest test Mach numbers respectively. The FX69-H-098, the NLR-1, the BHC-540, and the NACA 23012 airfoils were investigated in the 6- by 19-inch tunnel at Reynolds numbers from about 0.9 to 2.2 million at the lowest and highest test Mach numbers respectively. Author

DATA SUMMARY: Design coordinates and static pressure orifice locations for 5 airfoil models given in percent airfoil chord; variables include upper surface, lower surface, stations; 10 tables include numeric data.

N77-15000*# Texas A&M Research Foundation, College Station.
A WIND TUNNEL INVESTIGATION OF CIRCULAR AND STRAKED CYLINDERS IN TRANSONIC CROSS FLOW
John Macha Nov. 1976 39 p refs
(Grant NsG-2123)
(NASA-CR-149372; TAMU-3318-76-01) Avail: NTIS HC A03/MF A01 CSCL 01A

Pressure distributions around circular and circular/strake cylinders were measured in a wind tunnel at Mach numbers from 0.6 to 1.2 with Reynolds number independently variable from 10,000 to 100,000. The local pressures are integrated over the cylinder surface to determine the variation of drag coefficient with both Mach number and Reynolds number. Effects of tunnel blockage are evaluated by comparing results from circular cylinders of various diameters at common Mach and Reynolds number conditions. Compressibility effects are concluded to be responsible for a flight reduction of the drag coefficient near Mach 0.7. Drag increases with strake height, presumably approaching a maximum drag corresponding to a flat plate configuration. Author

DATA SUMMARY: Uncorrected drag coefficients for circular and straked models; variables include drag coefficient, strake height/cylinder diameter ratio, wake width, Mach number, blockage ratio, pressure coefficient, circumferential angle, Reynolds number; 14 figures and 2 tables include numeric data.

N77-15001# Aerospace Corp., El Segundo, Calif. Aerophysics Lab.
DISPERSION OF SPINNING MISSILES DUE TO LIFT NONAVERAGING Interim Report
Daniel H. Platus 28 Jun. 1976 37 p refs
(Contract F04701-75-C-0076)
(AD-A027582; TR-0076(6240-10)-4; SAMSO-TR-76-135) Avail: NTIS HC A03/MF A01 CSCL 16/3

A new source of cross-range dispersion is identified for spinning missiles. The dispersion is caused from wind-fixed moment perturbations that produce a strong coupling between angle of attack and lift vector precession rate, in contrast to body-fixed moment-induced dispersion of a rolling, trimmed missile in which lift and roll variations are generally uncoupled. Dispersion is shown to occur for initially untrimmed motion in which roll rate has little influence on the lift vector precession rate. Small wind-oriented moments can adversely affect the precession rate, and dispersion depends strongly on the initial motion conditions. Roll control is ineffective for limiting this type of dispersion, and effective control must provide some means of maintaining a steady, nonzero precession rate. Author (GRA)

DATA SUMMARY: Precession rate response to angle of attack and pitch and yaw moments; variables include jump, ramp duration, angle of attack, time, precession rate, velocity; 7 figures include numeric data.

N77-15002# Naval Ship Research and Development Center, Bethesda, Md. Ship Performance Dept.
THE VERTICAL MOTION OF AN AIR CUSHION VEHICLE AND THE SPATIAL DISTRIBUTION OF CUSHION PRESSURE
David D. Moran and Richard S. Schechter Apr. 1976 109 p refs
(AD-A027460; SPD-615-02; DTNSRDC-SPD-615-02) Avail: NTIS HC A06/MF A01 CSCL 13/10

The spatial and temporal distribution of pressure in the cushion of an air-cushion-supported vehicle operating over a rigid periodic wave field is reported. By comparing measured and computed angular (pitch) accelerations, it is shown that the spatial pressure distribution is the major mechanism for pitch excitation of the vehicle. The heave motion is found to be more dependent upon other mechanisms for the vertical excitation forces. Various forms of the spatial pressure distribution are examined using experimental data. GRA

DATA SUMMARY: Motion of air cushion vehicle as calculated from pressure distribution and measure by accelerometers on a scale model; variables include encounter frequency, pitch acceleration, heave acceleration, wavelength/cushion length, pressure ratio, pressure phase angle difference, dimensions; 46 figures and 2 tables include numeric data.

N77-15003# Army Missile Research, Development and Engineering Lab., Redstone Arsenal, Ala. Aeroballistics Directorate.
COMPUTER PROGRAM FOR ESTIMATING STABILITY DERIVATIVES OF MISSILE CONFIGURATIONS
William D. Washington 13 May 1976 78 p refs
(DA Proj. 1M3-62303-A-214)
(AD-A027036; RD-76-25) Avail: NTIS HC A05/MF A01 CSCL 16/4

This report describes a computer program for estimating the stability coefficients of typical missile configurations with wings or tail fins or both. The Mach range is from zero to approximately 4.5. The roll orientation is zero (plus configuration). Wings and tails must be in-line. Controls are included (ogive cylinder or cone cylinder); however, body alone tables can be input if desired. A conical boattail segment can be added. The program does not predict drag data. Static stability and damping derivatives at zero angle of attack are predicted by this program. GRA

DATA SUMMARY: Mach range and other limits of nine subroutines; variables include Mach range, speed, lift, aerodynamic center, center of pressure, radius, tail interference factor, angle of attack, body diameter, rolling moment; 11 figures and 2 tables include numeric data.

N77-15004# ARO, Inc., Arnold Air Force Station, Tenn.
EXPERIMENTAL ROLL-DAMPING, MAGNUS, AND STATIC-STABILITY CHARACTERISTICS OF TWO SLENDER MISSILE CONFIGURATIONS AT HIGH ANGLES OF ATTACK (0 TO 90 DEGREES) AND MACH NUMBERS 0.2 THROUGH 2.5 Final Report, 16 Jun. - 18 Sep. 1975
Leroy M. Jenke AEDC Jul. 1976 116 p refs
(AF Proj. 8219; ARO Proj. V41A-A8A)
(AD-A027027; ARO-VKF-TR-76-13; AEDC-TR-76-58) Avail: NTIS HC A06/MF A01 CSCL 16/4

An experimental investigation was conducted to verify that the recently developed high-alpha missile roll-damping test mechanism could be used to obtain the roll-damping characteristics of slender missile configurations and to obtain roll-damping, Magnus, static-stability, and axial-force characteristics of a typical missile configuration. The verification tests were conducted with the Basic Finner Model at Mach 0.22 and 2.50. Additional test results were obtained with a Modified Basic Finner Model for Mach number 0.6 through 2.5. GRA

DATA SUMMARY: Aerodynamic characteristics and ratios using Basic Finner Method; variables include directional stability, axial force characteristics, static longitudinal stability characteristics, angle of attack, moment characteristics, magnus force, nonlinear damping, support system, Reynolds number, spin, bearing; 18 figures and 7 tables include numeric data.

N77-15005# Naval Ship Research and Development Center, Bethesda, Md. Aviation and Surface Effects Dept.
TWO-DIMENSIONAL SUBSONIC WIND TUNNEL EVALUATION OF A 20-PERCENT-THICK CIRCULATION CONTROL AIRFOIL Final Report
Jane Abramson Jun. 1975 33 p refs
(AD-A027164; DTNSRDC-ASED-331) Avail: NTIS

HC A03/MF A01 CSCL 20/4

A circulation control uncambered elliptic airfoil section with a thickness-to-chord ratio of 0.20 was tested subsonically to determine its aerodynamic characteristics. Lift coefficients up to 5 were produced at momentum coefficients, of 0.24. The initially high unblown drag coefficients, characteristic of bluff trailing edge airfoils, were greatly reduced at low values of momentum coefficient. It was therefore possible to produce equivalent lift-to-drag ratios in excess of 30 when Cl = 1.0. The ability to produce high lift coefficients essentially independent of angle of attack is indicated by the results of this investigation.

Author (GRA)

DATA SUMMARY: Wind tunnel tests of tangential blowing over the bluff trailing edge of a 20-percent uncambered ellipse; variables include lift coefficient, momentum coefficient, angle of attack, pressure coefficient, duct pressure, slot height, augmentation ratio, half-chord pitching moment, lift-drag ratio; 15 figures and 2 tables include numeric data.

N77-15006# Naval Postgraduate School, Monterey, Calif. Dept. of Mechanical Engineering.

TRANSVERSE FORCES ON SMOOTH AND ROUGH CYLINDERS IN HARMONIC FLOW AT HIGH REYNOLDS NUMBERS M.S. Thesis

Neil Jon Collins Jun. 1976 107 p refs

(AD-A027247) Avail: NTIS HC A06/MF A01 CSCL 20/4

The transverse forces acting on smooth and sand-roughened circular cylinders immersed in an harmonically oscillating flow have been measured using a recently constructed U-shaped water tunnel. The lift coefficient and the frequency of the alternating force have been determined. For smooth cylinders, the lift coefficients were found to depend on both the Reynolds and the Keulegan-Carpenter numbers for Reynolds numbers between about 20,000 and 150,000. For rough cylinders, the lift coefficients were found to be independent of the Reynolds number within the range of relative roughnesses and Reynolds numbers tested. The results have also shown that the lift coefficients for smooth cylinders at low Reynolds numbers are nearly identical with those obtained for rough cylinders at very high Reynolds numbers at the corresponding amplitude ratios. For both rough and smooth cylinders, the transverse force is a significant fraction of the in-line force and must be taken into consideration in the design of structures. It is recommended that the experiments be extended to the self-excited hydro-elastic oscillations of cylinders in harmonic flows. Author (GRA)

DATA SUMMARY: Measurements of transverse forces acting on smooth and rough cylinders immersed in a harmonically oscillating flow; variables include transverse force coefficient, acceleration, cylinder diameter, blockage ratio, span-diameter ratio, Keulegan-Carpenter number, Reynolds number, relative frequency of vortex shedding; 20 figures and 37 tables include numeric data.

N77-14986# De Havilland Aircraft Co. of Canada Ltd., Ottawa (Ontario).

STOL DEVELOPMENTS

J. P. Uffen *In* AGARD 11th AGARD Ann. Meeting Feb. 1976 p 22-41 refs (For primary document see N77-14982 06-01)

Avail: NTIS HC A04/MF A01

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N77-15007*# Lockheed-California Co., Burbank.

STUDY OF THE COST/BENEFIT TRADEOFFS FOR REDUCING THE ENERGY CONSUMPTION OF THE COMMERCIAL AIR TRANSPORTATION SYSTEM Final Report, Nov. 1974 - Mar. 1976

John P. Hopkins Aug. 1976 331 p refs

(Contract NAS2-8612)

(NASA-CR-137926; LR-27769-2) Avail: NTIS HC A15/MF A01 CSCL 05C

Practical means were assessed for achieving reduced fuel consumption in commercial air transportation. Five areas were investigated: current aircraft types, revised operational procedures, modifications to current aircraft, derivatives of current aircraft and new near-term fuel conservative aircraft. As part of a multiparticipant coordinated effort, detailed performance and operating cost data in each of these areas were supplied to the contractor responsible for the overall analysis of the cost/benefit tradeoffs for reducing the energy consumption of the domestic commercial air transportation system. A follow-on study was performed to assess the potential of an advanced turboprop transport aircraft concept. To provide a valid basis for comparison, an equivalent turbofan transport aircraft concept incorporating equal technology levels was also derived. The aircraft as compared on the basis of weight, size, fuel utilization, operational characteristics and costs. Author

N77-15008*# Lockheed-California Co., Burbank.

STUDY OF THE COST/BENEFIT TRADEOFFS FOR REDUCING THE ENERGY CONSUMPTION OF THE COMMERCIAL AIR TRANSPORTATION SYSTEM Summary Report, Nov. 1974 - Mar. 1976

John P. Hopkins and H. E. Wharton Aug. 1976 100 p

(Contract NAS2-8612)

(NASA-CR-137927; LR-27769-1) Avail: NTIS HC A05/MF A01 CSCL 05C

For abstract, see N77-15007.

N77-15009# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

AERONAUTICAL SYSTEMS TECHNOLOGY NEEDS: ESCAPE, RESCUE, AND SURVIVAL Annual Report, Jan. - Dec. 1976

Donald C. Kittinger Jun. 1976 16 p

(AD-A026021; ASD-TR-76-12; ASD-TR-75-15) Avail: NTIS HC A02/MF A01 CSCL 06/11

This report is a part of a compiliation of formalized Technology Needs (TN) Reports covering Personnel Subsystems and Support Subsystems as identified by the Aeronautical Systems Division. They are based on development/operational experience, systems studies and new concepts - all related to future system applications. Their presentation is to serve a threefold purpose; i.e., (1) guidance for technology program, (2) proven developmental potential, and (3) engineering data/requirements essential for technology use in systems. GRA

N77-15010# Stanford Research Inst., Menlo Park, Calif.

DSTAR: DIRECT SEA-TO-AIR REFUELING (INFLIGHT REFUELING OF MILITARY CARGO AIRCRAFT FROM SHIPS AT SEA)

Richard L. Garwin Jun. 1976 19 p refs

(Contract DAHC15-73-C-0370; ARPA Order 2504; SRI Proj. 3000)

(AD-A026750; SRI-JSR-75-9) Avail: NTIS HC A02/MF A01 CSCL 15/5

Preliminary analysis shows that military cargo and combat aircraft can refuel in five minutes directly from a tanker in the ocean (or a depot on land) by flying in a tight circle while connected to a refueling mast by means of a hose through which fuel is pumped. The aircraft need not carry a hose, cable, or winch. A bank angle of 45 deg, a circle of radius 400 m, pump pressure of 1500 psi, and aircraft altitude of 120 m allow DSTAR of aircraft from 25 to 350 tons gross. For a C-5A at 350 tons weight, the hose tension is 20 tons; for a 25-ton fighter a lighter hose is used. For the smaller aircraft the hose should be faired to reduce drag. GRA

N77-15011# National Weather Service, Silver Spring, Md. Equipment Development Lab.

RADIOSONDE FRANGIBILITY TEST (RADIOSONDE IMPACT TO AIRCRAFT)

Melvin J. Sanders and W. Ray Price Mar. 1976 77 p

(PB-258423/3; NOAA-TM-NWS-EDL-14; NOAA-76071901)

Avail: NTIS HC A05/MF A01 CSCL 04A

The results of the radiosonde frangibility test program--radiosonde impact to aircraft--are presented. The tests were to determine if it is safe for an operational type radiosonde and/or the experimental radiosonde to impact an aircraft cruising at approximately 500 mph in an altitude range of 25,000 to 35,000 feet. A total of 15 impacts were simulated, 14 against the windshields and 1 against the sheet metal of a Boeing 707 nose section mounted on a flat bed rocket sled. The tests show that the operational type radiosonde and the experimental radiosonde do not violate current FAA regulations in that they do not penetrate the windshield at impact. GRA

N77-14987# Canadian Air Transportation Administration, Ottawa.

OVERVIEW OF THE CANADIAN MINISTRY OF TRANSPORT'S STOL DEMONSTRATION

F. C. Black *In* AGARD 11th AGARD Ann. Meeting Feb. 1976 p 42-44 (For primary document see N77-14982 06-01) Avail: NTIS HC A04/MF A01

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications*.

N77-15012# Department of Transportation, Cambridge, Mass.

CONTROLLER/COMPUTER INTERFACE WITH AN AIR-GROUND DATA LINK Final Report, Jan. - May 1975

J. Hagopian and T. Morgan (Computer Sciences Corp., Silver Spring, Md.) Jun. 1976 149 p refs

(Contract DOT-FA513/R6131)

(AD-A031070/6; DOT-TSC-FAA-75-23; FAA-RD-76-91) Avail: NTIS HC A07/MF A01 CSCL 17/7

Three candidate control and display modes were evaluated to determine the most suitable for the display and dispatch of computer-generated M&S commands in a mixed voice/digital communications environment. The three modes tested were control-by-approval/full data block (CBA/FDB), control-by-approval/tabular list (CBA/TAB), and control-by-exception/full data block (CBE/FDB). In control-by-approval, the controller must approve each command; in control-by-exception, the controller must intervene to disapprove commands that are otherwise automatically dispatched. Figures of merit for evaluating the three modes included subjective data in the form of questionnaires from participating controllers and objective data such as message transaction time, command initiation delay, service time, and instantaneous aircraft load. The results of 66 hours of testing with six air traffic controllers show that the fully automated CBE/FDB control mode is preferred because it possesses the best workload, capacity and stress characteristics. Author

N77-15013# National Aviation Facilities Experimental Center, Atlantic City, N.J.

TERMINAL INFORMATION PROCESSING SYSTEM CONCEPT TESTING (CONTROL TOWER) Final Report, Jan. - May 1975

Hamilton T. Rohland, Theodore W. Rundall, and Michael J. Verno Sep. 1976 40 p

(AD-A031151/4; FAA-NA-75-21; FAA-RD-76-143) Avail: NTIS HC A03/MF A01 CSCL 17/7

Simulations were conducted using the Flight Data Distribution System to evaluate two concepts of a Terminal Information Processing System (TIPS) using electronic display of flight information as a replacement for printed paper flight strips in airport traffic control towers associated with high density automated radar terminal system. It was concluded that paper flight strips can be replaced successfully by an electronic system. Recommendations were made to remedy those deficiencies that were discovered during the concept testing. Author

N77-15014# Mitre Corp., McLean, Va.

PERFORMANCE TEST REQUIREMENTS FOR THE DISCRETE ADDRESS BEACON SYSTEM (DABS) ENGINEERING MODELS Final Report

Robert W. Lautenschlager and Paul R. Purcell Sep. 1976 84 p

(Contract DOT-FA69NS-162)

(AD-A031130/8; MTR-7275; FAA-RD-76-147) Avail: NTIS HC A05/MF A01 CSCL 17/7

Technical requirements for performance testing of the Discrete Address Beacon System are presented. The technical requirements are specified in terms of test objectives for DABS single site and multisite performance tests. The objectives are organized into the following test stages: Surveillance, Communications, Failure/Recovery Modes, Capacity/Response Time, and Functional Reliability and Maintainability. Specific objectives for the various tests within each of these stages are described. Author

N77-15015# Federal Aviation Administration, Washington, D.C.

TECHNICAL PROGRESS IN THE US DEVELOPMENT OF A MICROWAVE LANDING SYSTEM Progress Report, Jul. 1971 - Jun. 1974

Sep. 1976 227 p

(AD-A031150/6; FAA-RD-74-187) Avail: NTIS HC A11/MF A01 CSCL 17/7

Abbreviated background information on the microwave landing system development program is presented. Technical progress made between July 1971 and July 1974 is reported. The selection of the better technique scanning beam or Doppler and of associated signal format for prototype development is discussed. Author

N77-15016# Federal Aviation Administration, Washington, D.C.

CENTRAL FLOW CONTROL COMPUTER PROGRAM SPECIFICATIONS. VOLUME 1: INTRODUCTION TO SPECIFICATIONS SERIES, SYSTEM OVERVIEW Final Report

Sep. 1976 27 p ref

(AD-A031165/4; FAA-RD-76-157-Vol-1; Rept-111-102-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 17/7

Specifications for the central flow control computer program, and an overview of the automated system on which the program functions are presented. A description is given of the system application, the data processing configuration, program interfaces, system operations, software capabilities, and the remainder of the specification series. Author

N77-15017# Federal Aviation Administration, Washington, D.C.

CENTRAL FLOW CONTROL COMPUTER PROGRAM SPECIFICATIONS. VOLUME 3: OFF-LINE SUPPORT SUBSYSTEM SPECIFICATION Final Report

Sep. 1976 82 p

(AD-A031180/3; FAA-RD-76-157-Vol-3; Rept-111-102-Vol-3) Avail: NTIS HC A05/MF A01 CSCL 15/5

Detailed functional specifications are presented for off-line support subsystems for the central flow control computer program. Topics included are data recording and analysis, data base support, system build, system test, and management aid software components of the system. Author

N77-15018# Federal Aviation Administration, Washington, D.C.

CENTRAL FLOW CONTROL COMPUTER PROGRAM SPECIFICATIONS. VOLUME 4: DATA BASE SUBSYSTEM SPECIFICATION Final Report

Sep. 1976 75 p

(AD-A031210/8; FAA-RD-76-157-Vol-4; Rept-111-102-Vol-4) Avail: NTIS HC A04/MF A01 CSCL 17/7

The structure of the data base is defined describing the physical and logical characteristics of the individual files contained in the data base. Data base management functions are specified. This involves the processing, program logic and interfaces required to access the data base for reading and updating the contents, and to accomplish the necessary maintenance functions. Interrelationships between the on-line and the off-line support system in reference to the data base are discussed. Author

N77-15019# Federal Aviation Administration, Washington, D.C.

CENTRAL FLOW CONTROL COMPUTER PROGRAM

SPECIFICATIONS. VOLUME 5: EXECUTIVE SUBSYSTEM SPECIFICATION Final Report
Sep. 1976 47 p refs
(AD-A031167/0; FAA-RD-76-157-Vol-5; Rept-111-102-Vol-5)
Avail: NTIS HC A03/MF A01 CSCL 17/7

Specifications for the executive subsystems of the central flow control computer program are presented. Requirements are discussed for the system's resource management, error analysis, reconfiguration, startup and startover, system analysis recording, input/output message, testing, and supervisor call components. Author

N77-15020# Westland Helicopters Ltd., Yeovil (England).
IN SEARCH OF A RADAR FOR THE ITV SYSTEM
O. L. L. Fitzwilliams Sep. 1976 72 p refs
(RP-532) Avail: NTIS HC A04/MF A01

A system of air transport for the future, based on the concept of the Independently Targeted Vehicle (ITV) is described. Operation of very large numbers of small vehicles offers the traveller an automatic airborne traverse at 200kt ground speed between air stations very close to the origin and destination of any journey. Simulations have demonstrated stable collisionless traffic at high density but assurance was required that suitable radar equipment can be developed. A form of radar which would be effective was identified, free of interference and within acceptable dimensions and cost. Author

N77-15021*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PRECISE TIME DISSEMINATION EXPERIMENT USING THE ATS-1 SATELLITE Final Report
A. R. Chi Oct. 1975 150 p
(Contract DOT-FA72WAI-300)
(NASA-TM-X-74273; GSFC-636-18-51-08; AD-A029311/8; FAA-RD-76-135) Avail: NTIS HC A07/MF A01 CSCL 17/7

A precise time transfer experiment using the Application Technology Satellite (ATS) as a link between a master and slave station achieved an accuracy of 50 nanoseconds one sigma. The technique is inherently capable of transferring precise time on a real time basis from a master time station to a number of slave stations. A conventional pseudo random noise (PN) code is used because of its spread spectrum properties. The low energy density and noise like signals can be transmitted coexisting with other transmissions without interference. Thus, the time transfer could be achieved via an existing satellite service. Author

N77-15022# Facility Checking Squadron (1866th) (AFCS), Richards-Gebaur AFB, Mo.
RADAR STATION EVALUATION REPORT DOVER, AFB, DELAWARE Final Report, 19 Feb. - 1 Mar. 1976
David E. Smith 2 Jun. 1976 88 p
(AD-A026584; Rept-76/66R-64) Avail: NTIS HC A05/MF A01 CSCL 17/9

This traffic control and landing systems (TRACALS) radar station evaluation report presents data collected to define the capabilities and limitations of the radar approach control (RAPCON) facility at Dover AFB, Delaware. The data presented in this report were collected during the evaluation period 19 Feb - 1 Mar 76. The RAPCON facility is comprised of an AN/FPN-47 airport surveillance radar (ASR), AN/TPX-42(A)V Type 3 air traffic control radar beacon system (ATCRBS), and associated power systems. This report includes descriptions of the useable radar coverage, the radar coverage diagrams, the ATCRBS coverage and tracking capabilities, the analysis of flight and equipment performance data, and the performance predictions for the ASR and ATCRBS systems. The data presented in this report are a guide for anticipated equipment performance until there is an addition, deletion, or relocation of equipment, or until a change occurs in the horizontal profile. Author (GRA)

N77-15023# National Bureau of Standards, Washington, D.C. Operations Research Section.
MATHEMATICAL APPROACHES TO EVALUATING AIRCRAFT VERTICAL SEPARATION STANDARDS Final Report, Oct. 1975 - May 1976
Judith F. Gilsinn May 1976 50 p refs
(Contract DOT-FA76WAI-594)
(PB-257195/8; NBSIR-76-1067) Avail: NTIS HC A03/MF A01 CSCL 01B

Many of the components of vertical position error are detailed and classified into three major categories: static pressure system error, altimeter instrument error, and pilot response error. Two models for use in evaluating separation standards, the root sum of squares approach and the Reich collision risk model, are described together with their respective advantages and disadvantages. A final section includes recommendations for a carefully designed data collection effort and discusses potentially important considerations for such a design. GRA

N77-15024# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
EFFECTS OF LOW-YIELD NUCLEAR WARHEADS ON AIRFIELD RUNWAYS
Landon K. Davis 1976 12 p
(AD-A025991/1) Avail: NTIS HC A02/MF A01 CSCL 15/6

Damage to airfield runways as a function of warhead yield, burst position, target characteristics, and geological environment is defined. Existing Army manuals stated that damage to runways should extend over a distance equal to 1.5 times the apparent crater diameter. At the onset of this study, it was felt that this estimate was grossly conservative, that effective damage to a runway by a buried nuclear burst might, in fact, be more than twice as extensive. GRA

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.

N77-15025 North Carolina State Univ., Raleigh.
PREDICTIONS OF LIGHT AIRCRAFT HORIZONTAL TAIL ONSET FLOWS: A REVIEW AND ANALYSIS Ph.D. Thesis
Delbert Clyde Summey 1976 116 p
Avail: Univ. Microfilms Order No. 76-28524

Analytical methods presented in the literature for the determination of onset flow in the vicinity of the horizontal tail of light aircraft are reviewed. The theoretical basis of the two computer programs (WASH and WAKE) is then developed in detail. WASH calculates the location of wake sheet streamlines behind the wing, and upwash and downwash angles ahead of and behind the wing respectively. WAKE computes two-dimensional velocity profiles along the wake streamlines given the upper and lower surface velocity profiles at the wing trailing edge. Comparisons with experiment indicate good agreement for wake location, downwash angles, and two dimensional velocity profiles at low to moderate angles of attack. Included is a discussion on the adaptation of the results of the two programs to predict the total onset flow at the tail. Dissert. Abstr.

N77-15026*# Rockwell International Corp., Los Angeles, Calif. Aircraft Div.
INVESTIGATION OF NORMAL SHOCK INLETS FOR HIGHLY MANEUVERABLE AIRCRAFT
Arnold W. Martin [1977] 321 p refs
(Contract NAS2-8955)
(NASA-CR-137970) Avail: NTIS HC A14/MF A01 CSCL 01C

Concepts are investigated for obtaining both low cowl drag and good inlet performance at high angles of attack. The effect of a canard on inlet performance for a kidney shaped inlet in each of two vertical locations is discussed along with a sharp lip two dimensional inlet on a canardless forebody. M.C.F.

N77-15027*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AIRCRAFT DESIGN CONCEPT Patent Application
Frank D. Neuman (Boeing Co., Seattle), Gottfried O. Friebel (Boeing Co., Seattle), and Armand Sigalla, inventors (to NASA) (Boeing Co., Seattle) Filed 15 Nov. 1976 10 p Sponsored by NASA

(NASA-Case-LAR-11852-1; US-Patent-Appl-SN-742035) Avail: NTIS HC A02/MF A01 CSCL 01C

The passenger cabin in commercial aircraft is divided into forward and aft compartments allowing the wing carry-through structure to occupy space ordinarily reserved for passengers. Benefits are a stronger, smaller, more weight-efficient wing structure, larger fuselage fineness ratio, reduced weight and drag and increased fuel economy. NASA

N77-15028*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

FLIGHT ASSESSMENT OF AN ATMOSPHERIC TURBULENCE MEASUREMENT SYSTEM WITH EMPHASIS ON LONG WAVELENGTHS

Richard H. Rhyne Washington Dec. 1976 31 p refs
(NASA-TN-D-8315; L-10888) Avail: NTIS HC A03/MF A01 CSCL 01C

A flight assessment has been made of a system for measuring the three components of atmospheric turbulence in the frequency range associated with airplane motions (0 to approximately 0.5 Hz). Results of the assessment indica*e acceptable accuracy of the resulting time histories and power spectra. Small residual errors at the airplane short period and Dutch roll frequencies (0.5 and 0.25 Hz, respectively), as determined from in-flight maneuvers in smooth air, would not be detectable on the power spectra. However, errors at approximately 0.25 Hz can be present in the time history of the lateral turbulence component, particularly at the higher altitudes where airplane yawing motions are large. An assessment of the quantities comprising the vertical turbulence component leads to the conclusion that the vertical component is essentially accurate to zero frequency. Author

N77-15029*# General Dynamics/Convair, San Diego, Calif.

LOW-FREQUENCY NOISE REDUCTION OF LIGHTWEIGHT AIRFRAME STRUCTURES Technical Report, Jun. 1975 - Aug. 1976

G. L. Getline Aug. 1976 68 p refs
(Contract NAS1-13910)
(NASA-CR-145104; CASD-NAS-76-032) Avail: NTIS HC A04/MF A01 CSCL 01C

The results of an experimental study to determine the noise attenuation characteristics of aircraft type fuselage structural panels were presented. Of particular interest was noise attenuation at low frequencies, below the fundamental resonances of the panels. All panels were flightweight structures for transport type aircraft in the 34,050 to 45,400 kg (75,000 to 100,000 pounds) gross weight range. Test data include the results of vibration and acoustic transmission loss tests on seven types of isotropic and orthotropically stiffened, flat and curved panels. The results show that stiffness controlled acoustically integrated structures can provide very high noise reductions at low frequencies wthout significantly affecting their high frequency noise reduction capabilities. Author

N77-15030# Army Missile Research, Development and Engineering Lab., Redstone Arsenal, Ala.

OPTICAL MEASUREMENT OF MISSILE WING DEFORMATION IN HIGH VELOCITY TESTS

Charles R. Christensen, J. Lynn Smith, Terry A. Martin, and Judson R. Griffin 1976 15 p refs
(AD-A025986) Avail: NTIS HC A02/MF A01 CSCL 14/5

Two optical methods were developed which can measure wing deformations using the sled track streak cameras and would minimize preparation of the test missile. One method developed involves viewing the reflection of a grid pattern on the surface of a mirror polished test wing. This is similar to that used in previous wind tunnel tests in which the grid was painted on the tunnel wall. For the sled tests the polished test wing reflects a grid pattern painted on one of the missile wings perpendicular to it. The test wing and grid are both moving at the same velocity, therefore the reflection of the grid on the test wing and the test wing itself can be photographed with the sled range streak cameras. The position of the grid reflection on the test wing is used to calculate the tangents to its surface and the spatial deformation or wing profile is found by curve fitting from a point of zero deformation. This technique was used in Hawk missile tests conducted at Holloman Air Force Base, New Mexico and test wing profiles were calculated from streak camera photographs taken at velocities of Mach 1.9 and Mach 2.1. A Moire analysis technique was also developed which requires ruling the wing with a grid pattern and photographing the ruled wing at two different angles both before and after deformation. GRA

N77-15031# Naval Electronics Lab. Center, San Diego, Calif.

A-7 ALOFT LIFE-CYCLE COST AND MEASURES OF EFFECTIVENESS MODELS Test and Evaluation Report, Jul. 1975 - Mar. 1976

R. A. Greenwell 1 Mar. 1976 49 p
(NELC Proj. F228)
(AD-A026206; NELC-TR-1982) Avail: NTIS HC A03/MF A01 CSCL 17/2

Economic analyses are being conducted to determine the measure of effectiveness of fiber-optic and coaxial-cable systems for combat aircraft. Participating are the Naval Electronics Laboratory Center, Naval Postgraduate School, and the McDonnell Aircraft Company. The naval activities have developed a Bottoms Up model and McDonnell Aircraft Company has developed a Top Down model. These two models will be utilized to compare and analyze the optimum system in terms of performance and cost. Author (GRA)

N77-15032# Sikorsky Aircraft, Stratford, Conn.

BONDED FIELD-REPLACEABLE ROTOR BLADE POCKET FOR THE CH-54B. VOLUME 1: DESIGN STUDY Final Report

John A. Longobardi Jun. 1976 158 p refs 2 Vol.
(Contract DAAJ02-73-C-0076;
DA Proj. 1F1-63204-DB-38-Vol-1)
(AD-A027206; UTRC/S64385-Vol-1; USAAMRDL-TR-75-25A)
Avail: NTIS HC A08/MF A01 CSCL 01/3

The present CH-54B main rotor blade consists of 28 nonstructural, trailing-edge fairings called pockets. Fourteen of these pockets are different in dimension because of the taper on the blade spar. The adhesive retaining the pockets to the blade is a high-temperature and -pressure system. For these reasons, damaged pockets are repaired at the factory because of high inventory of pockets and sophisticated tooling for the best-curing adhesive would be needed to make a field repair possible. Consequently, under previous contract with the Army (Contract DAAJ02-71-C-0022), the feasibility of developing a pocket and adhesive suitable for field application was investigated. The study resulted in a universal pocket design which could be utilized to replace any pocket on the CH-54B blade and an adhesive system which would cure at room temperature. GRA

N77-15033# Sikorsky Aircraft, Stratford, Conn.

BONDED FIELD-REPLACEABLE ROTOR BLADE POCKET FOR THE CH-54B. VOLUME 2: INSTRUCTION MANUAL Final Report, 5 Jun. 1973 - 5 May 1974

John A. Longobardi Jun. 1976 24 p 2 Vol.
(Contract DAAJ02-73-C-0076; DA Proj. 1F1-63204-DB-38)
(AD-A027280; SER-64385-Vol-2;
USAAMRDL-TR-75-25B-Vol-2) Avail: NTIS HC A02/MF A01 CSCL 01/3

Volume II presents the instructions for installing field-replaceable pockets on CH-54B main rotor blades. It is the end result of experience gained from in-house activity and army personnel installing pockets at Sikorsky's Stratford, Conn. plant and in the field at fort Wainwright, Alaska, and Fort Eustis, Va. The instruction manual is part of a self-contained kit which has all the necessary components to make a field repair. Volume I contains the results of pocket and adhesive development and evaluation; the final pocket design and adhesive were successfully proof load, fatigue, whirl and flight tested. Author (GRA)

N77-15034# Advisory Group for Aerospace Research and Development, Paris (France).

NONLINEAR EFFECTS IN AIRCRAFT GROUND AND FLIGHT VIBRATION TESTS

G. Haidl (Messerschmitt-Boelkow-Blohm G.m.b.H., Munich) Dec. 1976 21 p refs Presented at 43d Struct. and Mater. Panel Meeting, London, Sep. 1976
(AGARD-R-652; ISBN-92-835-1231-7) Avail: NTIS HC A02/MF A01

Examples of non-linear vibration behavior in ground resonance

tests of an aircraft are shown. Model tests for a simplified system with non-linear properties have been performed, to study the effects of friction and backlash with respect to ground resonance test and flight flutter test. With symmetric and asymmetric non-linear stiffness characteristics effects of amplitude dependent frequencies, mode coupling, mode asymmetries and the consequences in parameter identification in vibration tests are pointed out and discussed. In case of flutter critical modes the problems of apparent damping caused by non-linear system properties are shown, and recommendations are given to reach a representative flutter clearance with respect to this non-linear system behavior.
Author

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

N77-15035# Rockwell International Corp., Anaheim, Calif. Electronics Research Div.

VARIABLE TRANSMITTANCE VISOR FOR HELMET-MOUNTED DISPLAY Final Report, Jul. 1971 - Jun. 1973

John P. Dobbins Jul. 1976 81 p refs
(Contract F33615-71-C-1938; AF Proj. 579A)
(AD-A027177; C71-838/501; AMRL-TR-74-28) Avail: NTIS HC A05/MF A01 CSCL 15/5

Efficient operation of HMD's (helmet-mounted displays) requires the use of VTV's (Variable-transmittance visors) to maintain constant visual contrast between projected images and their backgrounds. No VTV's responding controllably or reversibly with rapidity had been developed prior to this program. A high-priority military objective was to encourage the design and development of such VTV's. An unsolicited proposal to the USAF, based on a new concept, suggested the use of a liquid optronic medium in a sandwich-cell visor configuration with automatic control of variable transmittance. Three such units were installed in flight helmets and delivered to the customer as airborne feasibility demonstrators. These accommodated variations in external brightness over a range greater than 80:1. Automatic regulation was provided from light sensors, behind the visors, connected to closed-loop, electronic controllers using 28-vdc aircraft power. Controllers were packaged as pocket-size units with self-contained batteries for emergency operation. Most effort was directed toward solving critical problems involved in the selection, processing, and fabrication of materials suitable for this application. Among the many mathematical relationships, both optical and optronic, put to practical use in the VTV design were several derived.
GRA

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion*.

N77-15036*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

APPARATUS AND METHOD FOR JET NOISE SUPPRESSION Patent Application

Lucio Mestrello, inventor (to NASA) Filed 23 Dec. 1976 17 p
(NASA-Case-LAR-11903-1; US-Patent-Appl-SN-753971) Avail: NTIS HC A02/MF A01 CSCL 20A

A method and apparatus are described for jet noise suppression through control of the static pressure of the jet and control of the rate of entrainment of ambient fluid into the jet downstream of the exhaust nozzle. The momentum flux is regulated over an extended region of the jet, affecting Reynolds stresses in the jet and the spreading angle of the jet. Static pressure is controlled through a long hollow, porous nozzle plug centerbody which may be selectively vented to ambient conditions, connected to a vacuum source, or supplied with fluids of various densities for injection into the stream. Additionally, sound in the jet may be channeled along the nozzle plug centerbody by injecting coolant such as a cryogenic fluid through the centerbody into the jet.
NASA

N77-15037*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECT OF CERAMIC COATING OF JT8D COMBUSTOR LINER ON MAXIMUM LINER TEMPERATURES AND OTHER COMBUSTOR PERFORMANCE PARAMETERS

Helmut F. Butze and Curt H. Liebert Dec. 1976 24 p refs
(NASA-TM-X-73581; E-9043) Avail: NTIS HC A02/MF A01 CSCL 21E

The effect of ceramic coating of a JT8D combustor liner was investigated at simulated cruise and takeoff conditions with two fuels of widely different aromatic contents. Substantial decreases in maximum liner temperatures and flame radiation values were obtained with the ceramic-coated liner. Small reductions in exhaust gas smoke concentrations were observed with the ceramic-coated liner. Other performance parameters such as combustion efficiency and emissions of unburned hydrocarbons, CO, and NOx were not affected significantly. No deterioration of the ceramic coating was observed after about 6 hours of cyclic operation including several startups and shutdowns.
Author

N77-15038*# Teledyne Continental Motors, Mobile, Ala. Aircraft Products Div.

SCREENING ANALYSIS AND SELECTION OF EMISSION REDUCTION CONCEPTS FOR INTERMITTENT COMBUSTION AIRCRAFT ENGINES

B. J. Rezy, J. E. Meyers, J. R. Tucker, and S. J. Stuckas Nov. 1976 202 p refs
(Contract NAS3-19755)
(NASA-CR-135074; TCM-5206) Avail: NTIS HC A10/MF A01 CSCL 21A

An analysis was conducted to screen, evaluate, and select three engine exhaust emission reduction concepts from a group of 14 candidate alternatives. A comprehensive literature search was conducted to survey the emission reduction technology state-of-the-art and establish contact with firms working on intermittent combustion engine development and pollution reduction problems. Concept development, advantages, disadvantages, and expected emission reduction responses are stated. A set of cost effectiveness criteria was developed, appraised for relative importance, and traded off against each concept so that its merit could be determined. A decision model was used to aid the evaluators in managing the criteria, making consistent judgements, calculating merit scores, and ranking the concepts. An Improved Fuel Injection System, Improved Cooling Combustion Chamber, and a Variable Timing Ignition System were recommended to NASA for approval and further concept development. An alternate concept, Air Injection, was also recommended.
Author

N77-15039*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A REVIEW OF SEVERAL PROPULSION INTEGRATION FEATURES APPLICABLE TO SUPERSONIC-CRUISE FIGHTER AIRCRAFT

Bobby L. Berrier Dec. 1976 58 p refs
(NASA-TM-X-73991) Avail: NTIS HC A04/MF A01 CSCL 21E

A brief review has been made of the propulsion integration features which may impact the design of a supersonic cruise fighter type aircraft. The data used for this study were obtained from several investigations conducted in the Langley 16-foot transonic and 4 by 4 foot supersonic pressure wind tunnels. Results of this study show: (1) that for conventional nozzle installations, contradictory design guidelines exist between subsonic and supersonic flight condition, (2) that substantial drag penalties can be incurred by use of dry power nozzles during supersonic cruise; and (3) that a new and unique concept, the

nonaxisymmetric nozzle, offers the potential for solving many of the current propulsion installation problems. Author

N77-15040# Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.
NOISE REDUCTION FOR BUSINESS AIRCRAFT Final Report
William J. Galloway, John F. Wilby, Colin G. Gordon, and John F. Mills Oct. 1976 228 p refs
(Contract DOT-FA75WA-3668)
(AD-A031149/8; BBN-3284; FAA-RD-76-125) Avail: NTIS HC A11/MF A01 CSCL 01/3

The noise reduction potential is analyzed for the business jet aircraft fleet registered in the United States as of 1975. Noise characteristics of each aircraft are defined at various thrust levels and noise reductions achievable for different design options are determined. Costs and performance penalties are assessed for each option in order to evaluate the consequences of lowering present FAR 36 Appendix C noise levels. The exhaust noise of all engines can be reduced significantly with multi-element nozzles. The addition of a lined ejector provides little additional noise reduction at greatly increased weight and performance penalties. Acoustic liners in exhaust ducts reduce fan or core noise for some engines, but inlet liners have little value. To assess noise reductions, a single number criterion is proposed, based on the effective perceived noise level contour that circumscribes a two square-mile area. It is recommended that takeoff noise be measured at 2.5 nautical miles from brake release. Author

N77-15041*# Pratt and Whitney Aircraft, East Hartford, Conn. Commercial Products Div.
ADVANCED SUPERSONIC PROPULSION STUDY, PHASE 3 Final Report
R. A. Howlett, J. Johnson, J. Sabatella, and T. Sewall Dec. 1976 158 p refs
(Contract NAS3-19540)
(NASA-CR-135148; PWA-5461) Avail: NTIS HC A08/MF A01 CSCL 21E

The variable stream control engine is determined to be the most promising propulsion system concept for advanced supersonic cruise aircraft. This concept uses variable geometry components and a unique throttle schedule for independent control of two flow streams to provide low jet noise at takeoff and high performance at both subsonic and supersonic cruise. The advanced technology offers a 25% improvement in airplane range and an 8 decible reduction in takeoff noise, relative to first generation supersonic turbojet engines. Author

N77-15042*# Kanner (Leo) Associates, Redwood City, Calif.
METHODS FOR CALCULATION OF THREE-DIMENSIONAL FLOW THROUGH A BLADE ROW OF A TURBOMACHINE
J. P. Veuillot Washington NASA Jan. 1977 29 p refs Transl. into ENGLISH from Rev. Franc. Mecan. (France), no. 55-56 (3d and 4th trimesters), 1975 p 19-29
(Contract NASw-2790)
(NASA-TT-F-17512) Avail: NTIS HC A03/MF A01 CSCL 21E

The difficulties of calculation in the field of aerodynamics in a turbomachine blade row involving unsteady and three-dimensional characteristics of a flow and dissipative properties of a fluid are reviewed; then simplifications are introduced. The basis of an asymptotic theory is presented. An iterative procedure is shown making it possible to solve these equations and introducing a meridional stream function. Methods which make it possible to calculate cascade flows are presented. Author

N77-15043*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
STUDY OF UNCONVENTIONAL AIRCRAFT ENGINES DESIGNED FOR LOW ENERGY CONSUMPTION
R. E. Neitzel, R. Hirschkron, and R. P. Johnston Dec. 1976 165 p refs
(Contract NAS3-19519)
(NASA-CR-135136; R76AEG597) Avail: NTIS HC A08/MF A01 CSCL 21E

A study of unconventional engine cycle concepts, which may offer significantly lower energy consumption than conventional subsonic transport turbofans, is described herein. A number of unconventional engine concepts were identified and parametrically studied to determine their relative fuel-saving potential. Based on results from these studies, regenerative, geared, and variable-boost turbofans, and combinations thereof, were selected along with advanced turboprop cycles for further evaluation and refinement. Preliminary aerodynamic and mechanical designs of these unconventional engine configurations were conducted and mission performance was compared to a conventional, direct-drive turofan reference engine. Consideration is given to the unconventional concepts, and their state of readiness for application. Areas of needed technology advancement are identified. Author

N77-15044*# Pratt and Whitney Aircraft, East Hartford, Conn.
ANALYSIS AND DESIGN OF DIGITAL OUTPUT INTERFACE DEVICES FOR GAS TURBINE ELECTRONIC CONTROLS Final Report
D. M. Newirth and E. W. Koenig Dec. 1976 66 p
(Contract NAS3-19898)
(NASA-CR-135135; PWA-5471) Avail: NTIS HC A04/MF A01 CSCL 21E

A trade study was performed on twenty-one digital output interface schemes for gas turbine electronic controls to select the most promising scheme based on criteria of reliability, performance, cost, and sampling requirements. The most promising scheme, a digital effector with optical feedback of the fuel metering valve position, was designed. Author

N77-15045*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THERMAL DESIGN AND ANALYSIS OF A HYDROGEN-BURNING WIND TUNNEL MODEL OF AN AIRFRAME-INTEGRATED SCRAMJET
Robert W. Guy, J. N. Mueller, S. Z. Pinckney, and L. P. Lee [1976] 83 p refs
(NASA-TM-X-73931) Avail: NTIS HC A05/MF A01 CSCL 21A

An aerodynamic model of a hydrogen burning, airframe integrated scramjet engine has been designed, fabricated, and instrumented. This model is to be tested in an electric arc heated wind tunnel at an altitude of 35.39 km (116,094 ft.) but with an inlet Mach number of 6 simulating precompression on an aircraft undersurface. The scramjet model is constructed from oxygen free, high conductivity copper and is a heat sink design except for water cooling in some critical locations. The model is instrumented for pressure, surface temperature, heat transfer rate, and thrust measurements. Calculated flow properties, heat transfer rates, and surface temperature distributions along the various engine components are included for the conditions stated above. For some components, estimates of thermal strain are presented which indicate significant reductions in plastic strain by selective cooling of the model. These results show that the 100 thermal cycle life of the engine was met with minimum distortion while staying within the 2669 N (600 lbf) engine weight limitation and while cooling the engine only in critical locations. Author

N77-15046# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
MINI RPV ENGINE NOISE REDUCTION Final Report, May 1974 - Aug. 1975
Ralph M. Shimovetz and Davey L. Smith Mar. 1976 97 p refs
(ARPA Order 2707; AF Proj. 2707)
(AD-A027638; AFFDL-TR-76-28) Avail: NTIS HC A05/MF A01 CSCL 20/1

The purpose of this effort was to investigate the reduction in radiated acoustic noise associated with two types of engines considered for power plants in small (75-100 lb.) remotely piloted vehicles (Mini RPV) in the class of the Praeire and Calere Aircraft. The two engines considered are approximately 5 HP; the first a rotary combustion (RC), the second a two stroke cycle reciprocating (P). The sound pressure levels were recorded using a semicircle arrangement of microphones in a free field and with various engine noise reduction devices installed. The engines were rotated such that a spherical definition of the acoustic pressures were made. From these data the sound power levels and directional characteristics were determined. Aural detection

analyses are performed for the most desirable noise reduction cases. The computed aural detection altitudes and the most significant sources of noise were defined. Author (GRA)

N77-15047# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
INVESTIGATION OF DUMP COMBUSTORS WITH FLAME HOLDERS Final Report, Feb. 1974 - May 1975
Frank D. Stull and Roger R. Craig May 1976 57 p refs
(AF Proj. 3012)
(AD-A026170; AFAPL-TR-76-15) Avail: NTIS HC A03/MF A01 CSCL 21/5

An experimental investigation was conducted on the addition of flameholders to the inlet duct of a 5 inch D dump combustor in an attempt to reduce combustor length. Basic flameholder configurations, percentage blockage, leading edge bluntness, and trailing edge contours were varied to characterize the significant features of flameholders. A parametric study was then conducted around the two best flameholder configurations in which combustor length-to-diameter ratio (L/D), characteristic length, inlet temperature, and chamber pressure were varied. Combustion efficiency and combustor pressure losses were determined from each of these runs and compared to previous results for the basic dump combustor. Results are presented which show a marked difference in performance with small changes in trailing edge contour. Increases of up to 30 points in combustion efficiency were obtained when the best flameholder was added to the basic dump combustor with a L/D = 3. GRA

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N77-15048 Cincinnati Univ., Ohio.
OPTIMAL INPUT DESIGN FOR PARAMETER IDENTIFICATION OF DYNAMIC SYSTEMS Ph.D. Thesis
Subrahmanyam Ramachandran 1976 124 p
Avail: Univ. Microfilms Order No. 76-27422

Nonlinear multi-input multi-output multi-parameter systems are considered. The design criterion is that the optimal input should minimize statistical correlations between parameters. The performance index for the control design is taken as a linear weighted sum of the squares of the correlation coefficients of the aerodynamic stability and control derivatives as computed from the Cramer-Rao lower bound matrix. The optimal control is bang-bang when the system is linear in control and amplitude constraint is imposed on the input. Optimal aileron and rudder inputs are designed for an F-8 aircraft with super-critical wing. Reducing the correlation results in improved estimates and confidence levels. Flight tests for parameter identification are designed for a light aircraft using optimal inputs. Simulations are carried out using the optimal inputs and lateral derivatives are extracted from flight data. Dissert. Abstr.

N77-15049*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
CONTROL METHODS FOR AIDING A PILOT DURING STOL ENGINE FAILURE TRANSIENTS
Ernest R. Nelson and Daniel B. DeBra Dec. 1976 177 p refs
(Grant NsG-2100)
(NASA-CR-149280) Avail: NTIS HC A09/MF A01 CSCL 01C

Candidate autopilot control laws that control the engine failure transient sink rates by demonstrating the engineering application of modern state variable control theory were defined. The results of approximate modal analysis were compared to those derived from full state analyses provided from computer design solutions. The aircraft was described, and a state variable model of its longitudinal dynamic motion due to engine and control variations was defined. The classical fast and slow modes were assumed to be sufficiently different to define reduced order approximations of the aircraft motion amendable to hand analysis control definition methods. The original state equations of motion were also applied to a large scale state variable control design program, in particular OPTSYS. The resulting control laws were compared with respect to their relative responses, ease of application, and meeting the desired performance objectives. Author

N77-15050# Martin Marietta Aerospace, Orlando, Fla.
DEVELOPMENT OF A LOW COST MOLDED PLASTIC MISSILE/RPV CONTROL SURFACE ACTUATOR Final Report, Dec. 1973 - Aug. 1975
James R. Hickey Wright-Patterson, AFB., Ohio AFFDL Oct. 1975 112 p
(Contract F33615-74-C-3013; AF Proj. 1987)
(AD-A026700; OR-13965; AFFDL-TR-75-120) Avail: NTIS HC A06/MF A01 CSCL 19/9

Hydraulic actuators used to control the fins of tactical missiles are typically fabricated from aluminum and steel alloys in a manner that requires external machining operations. These machining operations normally account for a large portion of the costs of such actuators. To reduce costs, Martin Marietta Aerospace investigated the feasibility of making such an actuator out of molded plastic material by designing, fabricating and testing three complete hydraulic actuators for the Air Force Flight Dynamics Laboratory. Author (GRA)

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N77-15051# ARO, Inc., Arnold Air Force Station, Tenn. VonKarman Gas Dynamics Facility.
A MATHEMATICAL MODEL FOR THE STARTING PROCESS OF A TRANSONIC LUDWIEG TUBE WIND TUNNEL
F. L. Shope 29 Oct. 1976 29 p refs Backup document for AIAA Synoptic scheduled for publication in Journal of Aircraft in May 1977
Avail: NTIS HC A03/MF A01

Efforts are made to mathematically model the aerodynamics involved in the unsteady process of starting a Ludwieg tube wind tunnel. The model represents a large amount of experimental data obtained from a transonic Ludwieg tube facility and, thus, depends on several experimentally derived parameters and assumptions. The wind tunnel configuration consists of a very long, circular supply tube which contracts to a rectangular, porous-walled test section. The test section expands through a diffuser into a valve manifold. Surrounding the test section is a plenum chamber with exhaust valves which can be controlled independently of the main valves. The plenum contains a set of ejector flaps which allow the plenum to exhaust itself into the diffuser. Author

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N77-15052*+ National Aeronautics and Space Administration, Washington, D.C.
HIGHLIGHTS OF 1976 ACTIVITIES
Mary Fitzpatrick 29 Dec. 1976 20 p
(NASA-News-Release-76-215; P76-10212) Avail: NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 22A

Highlights of NASA's 1976 activities are summarized. Sixteen successful launches were made. Two landings of Viking spacecraft on Mars and rollout of the space shuttle orbiter are reviewed. Applications of aerospace science to education, health care, and community services are also discussed. J.A.M.

N77-15053* + National Aeronautics and Space Administration, Washington, D.C.
NASA TO LAUNCH NATO III-B COMMUNICATIONS SATELLITE
Bill ODonnell 29 Dec. 1976 14 p
(NATO Proj. III-B)
(NASA-News-Release-77-5; P77-10004) Avail: NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 22A

Launching of the NATO-iii-B communications satellite is discussed. The spacecraft and the Delta 2914 Launch Vehicle are briefly described. J.M.S.

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

N77-15054*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IMS/SATELLITE SITUATION CENTER REPORT: ORBIT PLOTS AND BAR CHARTS FOR PROGNOZ 4, DAYS 1-91 1976
Dec. 1976 116 p refs
(NASA-TM-X-72607; Rept-8) Avail: NTIS HC A06/MF A01 CSCL 22A

Orbit plots for the Prognoz 4 satellite for the time period January to March 1976 are given. This satellite was identified as a possible important contributor to the International Magnetospheric Study project. The orbits were based on an element epoch of December 26, 1975, 3h 8min and 17s. In view of the low perigee of this satellite, the Satellite Situation Center (SSC) considered that the effect of atmospheric drag precludes orbit predictions for the length of time normally used by the SSC for high-altitude satellites. Consequently, orbit data are shown for the first 3 months of 1976 only. The orbit generated for this report was based on the earlier epoch, and it positions the satellite within 30s of the ascending node at the later epoch. Therefore, within the accuracy of the plots shown in this report, the orbit used was regarded as an achieved orbit. The orbit information is displayed graphically in four ways: bar charts, geocentric solar ecliptic plots, boundary plots, and solar magnetic latitude versus local time plots. The most concise presentation is the bar charts. The bar charts give the crude three-dimensional position of the satellite for each magnetospheric region. Author

N77-15055# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
ASTRONAUT MANUAL EVA GUIDANCE: AN OPERATIONAL PROCEDURE M. S. Thesis
David Barnett Higgins Dec. 1975 82 p refs
(AD-A026267; AFIT-CI-76-33) Avail: NTIS HC A05/MF A01 CSCL 22/1

The exact, unperturbed, two-body equations of motion of an astronaut about the center of the earth are derived for an orbiting coordinate system. These equations are used as the equations of the astronauts motion relative to the space shuttle, which is located at the coordinate origin. A non-pictorial display scheme is developed for use with an interactive computer simulation which uses the above mentioned equations of relative motion. A method of plotting a field of nominal intercept paths is presented along with a procedure for using such a plot as a guidance aid. Simulations using this procedure are described. An appendix contains the description of a light weight, non-mechanical range estimation aid. GRA

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air)*.

N77-15056*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
USER GUIDE TO A COMMAND AND CONTROL SYSTEM; A PART OF A PRELAUNCH WIND MONITORING PROGRAM
Glenn R. Cowgill Nov. 1976 29 p
(NASA-TM-X-73558; E-8999) Avail: NTIS HC A03/MF A01 CSCL 14B

A set of programs called Command and Control System (CCS), intended as a user manual, is described for the operation of CCS by the personnel supporting the wind monitoring portion of the launch mission. Wind data obtained by tracking balloons is sent by electronic means using telephone lines to other locations. Steering commands are computed from a system called ADDJUST for the on-board computer and relays this data. Data are received and automatically stored in a microprocessor, then via a real time program transferred to the UNIVAC 1100/40 computer. At this point the data is available to be used by the Command and Control system. Author

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

N77-15057*# Scientific Translation Service, Santa Barbara, Calif.
THE CURRENT TREND OF THE UTILIZATION OF EARTH OBSERVATION SATELLITES, VOLUME 1
Washington NASA Jan. 1977 196 p refs Transl. into ENGLISH from Natl. Space Develop. Agency of Japan (NASDA) Report, v. 1, Mar. 1976 p 1-124
(Contract NASw-2791)
(NASA-TT-F-17500) Avail: NTIS HC A09/MF A01 CSCL 22A

A comprehensive report is presented on the requirements and effectiveness in each case of utilizing the satellite data in such areas as agriculture, forestry, land use, geology, mineral resources, water resources, environment, oceanography, and disaster prevention. An attempt was made to evaluate the possible applicability of the Space Remote Sensing Technology to each of the above areas. Author

N77-15058*# Rockwell International Corp., El Segundo, Calif.
LANDSAT/MMS PROPULSION MODULE DESIGN. VOLUME 1: TASK 4.3, TRADE STUDIES Final Report
J. M. Mansfield, F. G. Etheridge, and J. Indrikis 24 Sep. 1976 96 p refs
(Contract NAS5-23524)
(NASA-CR-144847; SD-76-SA-0095-1-Vol-1) Avail: NTIS HC A05/MF A01 CSCL 22B

Evaluations are presented of alternative LANDSAT follow-on launch configurations to derive the propulsion requirements for the multimission modular spacecraft (MMS). Two basic types were analyzed including use of conventional launch vehicles and shuttle-supported missions. It was concluded that two sizes of modular hydrazine propulsion modules would provide the most cost-effective combination for future missions of this spacecraft. Conceptual designs of the selected propulsion modules were performed to the depth permitting determination of mass properties and estimated costs. Author

N77-15059*# Rockwell International Corp., El Segundo, Calif.
LANDSAT/MMS PROPULSION MODULE DESIGN. TAS4.4:

CONCEPT DESIGN Final Report
J. M. Mansfield, F. G. Etheridge, and J. Indrikis 24 Sep. 1976 94 p refs
(Contract NAS5-23524)
(NASA-CR-144851; SD-76-SA-0095-2) Avail: NTIS HC A05/MF A01 CSCL 22B

Evaluations are presented of alternative LANDSAT follow-on launch configurations to derive the propulsion requirements for the multimission modular spacecraft (MMS). Two basic types were analyzed including use of conventional launch vehicles and shuttle supported missions. It was concluded that two sizes of modular hydrazine propulsion modules would provide the most cost-effective combination for future missions of this spacecraft. Conceptual designs of the selected propulsion modules were performed to the depth permitting determination of mass properties and estimated costs. Author

N77-15060*# TRW Defense and Space Systems Group, Redondo Beach, Calif.
DESIGN STUDY FOR LANDSAT D ATTITUDE CONTROL SYSTEM Interim Technical Report
R. P. Iwens, G. E. Bernier, and R. F. Hofstadter 15 Dec. 1976 175 p refs
(Contract NAS5-21188)
(NASA-CR-144848) Avail: NTIS HC A08/MF A01 CSCL 22B

A design and performance evaluation is presented for the LANDSAT D attitude control system (ACS). Control and configuration of the gimballed Ku-band antenna system for communication with the tracking and data relay satellite (TDRS). Control of the solar array drive considered part of the ACS is also addressed. Author

N77-15061*# Grumman Aerospace Corp., Bethpage, N.Y.
LANDSAT D INSTRUMENT MODULE STUDY
Dec. 1976 235 p
(NASA-CR-144849) Avail: NTIS HC A11/MF A01 CSCL 22B

Spacecraft instrument module configurations which support an earth resource data gathering mission using a thematic mapper sensor were examined. The differences in size of these two experiments necessitated the development of two different spacecraft configurations. Following the selection of the best-suited configurations, a validation phase of design, analysis and modelling was conducted to verify feasibility. The chosen designs were then used to formulate definition for a systems weight, a cost range for fabrication and interface requirements for the thematic mapper (TM). Author

N77-15062*# Hughes Aircraft Co., Culver City, Calif.
OSO-1 FINAL PROGRAM REPORT Final Report
Dec. 1975 62 p
(Contract NAS5-11400)
(NASA-CR-144846; HS331-5239) Avail: NTIS HC A04/MF A01 CSCL 22A

The performance of the OSO-1 control subsystem is described. On orbit telemetry data was compared with the system specifications and the results were tabulated. Wherever possible, the GMT time of the occurrence of the data used to describe the performance is given for cross reference purposes. Extensive comments are also included to assist in the interpretation of the data. Author

N77-15063*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPTIMAL REUSABLE-TUG AND EXPENDABLE-KICKSTAGE TRAJECTORIES FOR HIGH-ENERGY PLANETARY MISSIONS INCLUDING CORRECTION FOR NODAL PRECESSION
Janos Borsody Washington Dec. 1976 48 p refs
(NASA-TN-D-8387; E-8844) Avail: NTIS HC A03/MF A01 CSCL 22B

Equations are derived by using branched trajectory optimization techniques and the maximum principle to maximize the payload capability of a reusable tug/expendable kickstage vehicle configuration for planetary missions. The two stages and the payload are launched into a low earth orbit by a single space shuttle. The analysis includes correction for precession of the orbit. This correction is done by the tug. The tug propels the payload and the kickstage to an energy beyond earth escape and returns within a specified time to the precessed orbit. After separating from the tug, the kickstage accelerates the payload to the required injection conditions. Planetary injection conditions are specified by the mission energy and a fixed declination and right ascension of the outgoing asymptote. The multipoint boundary value problem resulting from the analysis is solved by a Newton-Raphson iteration technique. Partial derivatives of the boundary conditions are obtained by perturbing the initial conditions one at a time, integrating the trajectory and adjoint equations, and observing the changes in boundary conditions. Maximum payload capability is derived for two typical mission energies. In addition, the variations of several mission and stage parameters are also examined. Author

N77-15064*# Computer Sciences Corp., Los Angeles, Calif.
INTERNATIONAL ULTRAVIOLET EXPLORER (IUE) SATELLITE MISSION ANALYSIS
Ronald A. Cook and J. H. Griffin Sep. 1975 92 p
(Contract NAS5-11999)
(NASA-CR-144813; CSC/TM-75/6137) Avail: NTIS HC A05/MF A01 CSCL 22A

The results are presented of the mission analysis performed by Computer Sciences Corporation (CSC) in support of the International Ultraviolet Explorer (IUE) satellite. The launch window is open for three separate periods (for a total time of 7 months) during the year extending from July 20, 1977, to July 20, 1978. The synchronous orbit shadow constraint limits the launch window to approximately 88 minutes per day. Apogee boost motor fuel was computed to be 455 pounds (206 kilograms) and on-station weight was 931 pounds (422 kilograms). The target orbit is elliptical synchronous, with eccentricity 0.272 and 24 hour period. Author

N77-15065# Air Force Geophysics Lab., Hanscom AFB, Mass.
DISPERSION CONTROL SYSTEM FOR SOUNDING ROCKETS
James R. Pickell Mar. 1976 76 p
(AD-A027530; AFGL-TR-76-0044; AFGL-IP-246) Avail: NTIS HC A05/MF A01 CSCL 19/7

High altitude sounding rockets have always presented a problem to small test ranges such as WSMR because of rocket dispersion. This report presents a strap-on dispersion control system employing a 16-bit microprocessor as its brains that requires only software changes to accommodate different sounding rocket vehicles. Mostly the report contains a detailed explanation of the electronic hardware used, and the software developed, for a Paiute-Tomahawk sounding rocket. GRA

N77-15066# Lincoln Lab., Mass. Inst. of Tech., Lexington.
COMPUTER SOFTWARE FOR THE NAVY K-BAND SATELLITE COMMUNICATIONS TERMINAL
Dale A. McNeill 24 May 1976 55 p refs
(Contract F19628-76-C-0002)
(AD-A027220; TN-1976-25; ESD-TR-76-118) Avail: NTIS HC A04/MF A01 CSCL 17/2

A small general purpose computer is an integral part of the Navy experimental K-band communications terminal to provide the necessary computational power and flexibility. The computer functions include: (1) satellite orbit predictions for antenna tracking, (2) received signal integration and comparison for autotracking, (3) adjustments of transmitter power based on information derived from the downlink signal, (4) message editing and processing, (5) verification of correct terminal setup, and (6) recording of input parameters and performance data on magnetic tape for offline processing. Author (GRA)

N77-15067# Intelcom Rad Tech, San Diego, Calif.
QUASI-STATIC SYSTEM-GENERATED ELECTROMAGNETIC PULSE CODE FOR SATELLITE ANALYSIS. VOLUME 2: APPENDIXES 1 THROUGH 3
Daniel F. Higgins, R. Mark, and Michael A. Messier Kirtland AFB, N. Mex. AFWL May 1976 183 p refs Prepared in cooperation with Mission Research Corp.
(Contract F29601-74-C-0039)
(AD-A026474; RT-8111-070-Vol-2-App-1; AFWL-TR-75-141-Vol-2) Avail: NTIS HC A09/MF A01 CSCL 22/2

Investigations of lumped-element modeling techniques are performed for application to system-generated electromagnetic pulse (SGEMP) analyses of satellite systems. The thrust of the effort is twofold: (1) a quantification of errors introduced by the quasi-static approximation and other modeling approximations, and (2) the addition of a particle-pusher routine to the lumped-element model to obtain a self-consistent solution applicable to space-charge-limited problems. GRA

N77-15068# Air Force Geophysics Lab., Hanscom AFB, Mass.
PLASMA ENVIRONMENT OF A SYNCHRONOUS ORBIT SATELLITE Air Force Surveys in Geophysics
Arthur L. Pavel and Ludwig Katz 17 Feb. 1976 42 p refs (AF Proj. 8600)
(AD-A026029; AFGL-TR-76-0028; AFGL-AFSG-39) Avail: NTIS HC A03/MF A01 CSCL 22/2

Communication and earth observation satellites are frequently being placed in synchronous earth orbit. To increase the system life and survivability of these satellites, spacecraft designers and builders must better understand the synchronous space environment. The occurrence of environmentally linked anomalous behavior aboard several synchronous satellites has made the need for a better understanding of the synchronous environment particularly evident. During the next few years there is considerable activity planned towards characterizing the synchronous orbit environment, and these effects should provide the needed environmental definition. In the interim, this report is directed towards consolidating existing published data on synchronous conditions in a form useful to those currently having to make design decisions about synchronous space systems.
Author (GRA)

N77-15069# Dikewood Industries, Inc., Albuquerque, N. Mex.
ANALYTICAL CALCULATIONS ON PHOTOELECTRON-INDUCED CURRENTS ON A MODEL OF THE FLTSATCOM SATELLITE Final Report
L. Marin, K. S. H. Lee, and T. K. Liu Kirtland AFB, N. Mex. AFWL May 1976 61 p refs
(Contract F29601-75-C-0025; AF Proj. 4695)
(AD-A026591; AFWL-TR-75-147) Avail: NTIS HC A04/MF A01 CSCL 17/2

From a rigorous integral-equation formulation a simplified integro-differential equation is derived for the induced current on the boom of a FLTSATCOM satellite with the solar panels and the central cylinder replaced by some appropriate localized generators and lumped impedances driving and loading the boom. The induced currents result partly from (1) the motion of the photoelectrons near the satellite and partly from (2) the redistribution of the positive charges left behind by the ejected electrons. The simplified equation for the case of one moving electron is solved by the method of asymptotic expansion; explicit quasi-static as well as dynamic results are found both in time and frequency domain. It is found that the lowest resonance mode together with the quasi-static solution is sufficiently accurate for the photoelectron induced currents on the FLTSATCOM satellite. The quasi-static solution for one electron is also utilized to obtain the low-fluence result for a given incident photon pulse, a given yield function (electrons per photon), and a given angular and energy distribution of the ejected electrons. Throughout the report, the results computed from explicit analytical solutions are graphically presented and physically interpreted.
Author (GRA)

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation.*

N77-15070*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LOW POWER CAMAC AND NIM MODULAR SYSTEMS FOR SPACEFLIGHT USE ON SHUTTLE AND SPACELAB MISSIONS
James H. Trainor, Thomas J. Kaminski, and Charles H. Ehrmann Dec. 1976 6 p refs Submitted for publication
(NASA-TM-X-71255; X-660-76-276) Avail: NTIS HC A02/MF A01 CSCL 22B

The applicability of CAMAC and NIM to various payloads was studied. A major result is summarized in tabular form showing the applicability of standard available CAMAC and NIM modules to the six experimental payloads chosen. It was concluded that CAMAC has wide applicability within the experiments considered. Author

N77-15071*# Martin Marietta Corp., Denver, Colo.
PAYLOAD SPECIALIST STATION STUDY. VOLUME 1: EXECUTIVE SUMMARY Final Study Report
Nov. 1976 76 p 3 Vol.
(Contract NAS8-31789)
(NASA-CR-150130; MCR-76-403-Vol-1) Avail: NTIS HC A05/MF A01 CSCL 22B

The results of the Payload Specialist Station study are summarized. An optimum aft flight deck (AFD) controls and displays (C&D) configuration concept for payload operations within the Shuttle Orbiter were studied. The concept derived satisfied the large majority of identified payload C&D requirements through the 1980's, was cost effective, and utilized existing technology. The results are directly applicable to Phase C/D activities. Programmatic analyses, phase C/D program definition and schedules, and economic analyses were completed; and estimated phase C/D costs were identified. The AFD control and display concept was defined via panel layouts, CEI specifications, and programmatics for phase C/D. The study plan included the following six phases: (1) derive control and display requirements; (2) perform functional analyses; (3) perform system synthesis; (4) perform trade studies; (5) perform preliminary design; and (6) provide programmatics. Author

N77-15072*# Martin Marietta Corp., Denver, Colo.
PAYLOAD SPECIALIST STATION STUDY. VOLUME 2, PART 1: PRELIMINARY DESIGN DOCUMENT Final Study Report
Nov. 1976 126 p 3 Vol.
(Contract NAS8-31789)
(NASA-CR-150131; MCR-76-403-Vol-2-Pt-1) Avail: NTIS HC A07/MF A01 CSCL 22B

The details of six tasks of the payload Specialist Station study are discussed: (1) derive payload control and display requirements; (2) perform functional analyses; (3) perform system synthesis; (4) perform trade studies; (5) perform preliminary design; and (6) provide data format. Functional analysis diagrams were developed for the study payloads. These diagrams presented the payload's functional activities flow based on the six mission phases established. These phases are: (1) launch, ascent, orbit insertion; (2) on-orbit checkout and activation; (3) on-orbit operation; (4) deployment/retrieval; (5) on-orbit deactivation; and (6) descent, landing, post-landing. To perform system synthesis the widest variety of available hardware and software, as individual pieces of equipment and as systems, was investigated. The intent was to synthesize a complete AFD system or systems which could accommodate the range of requirements identified for the study missions. S.M.

N77-15073*# Martin Marietta Corp., Denver, Colo.
PAYLOAD SPECIALIST STATION STUDY. PART 2: CEI SPECIFICATIONS (PART 1) Final Study Report
Nov. 1976 210 p refs
(Contract NAS8-31789)
(NASA-CR-150132; MCR-76-403-Vol-2-Pt-2) Avail: NTIS HC A10/MF A01 CSCL 22B

The performance, design, and verification specifications are established for the multifunction display system (MFDS) to be located at the payload station in the shuttle orbiter aft flight deck. The system provides the display units (with video, alphanumerics, and graphics capabilities), associated with electronic units and the keyboards in support of the payload dedicated controls and the displays concept. Author

N77-15074*# Martin Marietta Corp., Denver, Colo.
PAYLOAD SPECIALIST STATION STUDY: VOLUME 2, PART 3: PROGRAM ANALYSIS AND PLANNING FOR

PHASE C/D Final Study Report
Nov. 1976 115 p 3 Vol.
(Contract NAS8-31798)
(NASA-CR-150133; MCR-76-403-Vol-2-Pt-3) Avail: NTIS HC A06/MF A01 CSCL 22B

The controls and displays (C&D) required at the Orbiter aft-flight deck (AFD) and the core C&D required at the Payload Specialist Station (PSS) are identified in this document. The AFD C&D Concept consists of a multifunction display system (MFDS) and elements of multiuse mission support equipment (MMSE). The MFDS consists of two CRTs, a display electronics unit (DEU), and a keyboard. The MMSE consists of a manual pointing controller (MPC), five digit numeric displays, 10 character alphanumeric legends, event timers, analog meters, rotary and toggle switches. The MMSE may be hardwired to the experiment, or interface with a data bus at the PSS for signal processing. The MFDS has video capability, with alphanumeric and graphic overlay features, on one CRT and alphanumeric and graphic (tricolor) capability on a second CRT. The DEU will have the capability to communicate, via redundant data buses, with both the spacelab experiment and subsystem computers. Author

N77-15075*# Martin Marietta Corp., Denver, Colo.
PAYLOAD SPECIALIST STATION STUDY. VOLUME 3: PROGRAM STUDY COST ESTIMATES. PART 1: WORK BREAKDOWN STRUCTURE Final Study Report
6 Nov. 1976 56 p 3 Vol.
(Contract NAS8-31789)
(NASA-CR-150134; MCR-76-403-Vol-3-Pt-1) Avail: NTIS HC A04/MF A01 CSCL 22B

The work breakdown structure (WBS) for the Payload Specialist Station (PSS) is presented. The WBS is divided into two elements--PSS contractor and mission unique requirements. In accordance with the study ground rules, it is assumed that a single contractor, hereafter referred to as PSS Contractor will perform the following: (1) provide C and D hardware (MFDS and elements of MMSE), except for GFE; (2) identify software requirements; (3) provide GSE and ground test software; and (4) perform systems engineering and integration in support of the Aft Flight Deck (AFD) C and D concept. The PSS Contractor WBS element encompasses a core or standardized PSS concept. Payload peculiar C and D requirements identified by users will originate as a part of the WBS element mission unique requirements; these requirements will be provided to the PSS Contractor for implementation. Author

N77-15076*# General Electric Co., Philadelphia, Pa.
ONBOARD EXPERIMENT DATA SUPPORT FACILITY, TASK 1 REPORT
Sep. 1975 225 p refs
(Contract NAS9-14651)
(NASA-CR-151148) Avail: NTIS HC A10/MF A01 CSCL 22B

The conceptual design and specifications are developed for an onboard experiment data support facility (OEDSF) to provide end to end processing of data from various payloads on board space shuttles. Classical data processing requirements are defined and modeled. Onboard processing requirements are analyzed. Specifications are included for an onboard processor. Author

N77-15077*# TRW Defense and Space Systems Group, Redondo Beach, Calif.
STS PAYLOADS MISSION CONTROL STUDY (CONTINUATION PHASE) Executive Summary Review
Dec. 1976 93 p
(Contract NAS9-14484)
(NASA-CR-151153) Avail: NTIS HC A05/MF A01 CSCL 22B

User oriented space transportation system-payload mission control concepts are developed for optimum contribution of ground flight control support to onboard capability to meet STS payload objectives in a cost effective manner. Flight control ground functions are identified for representative payloads. Present and planned NASA facilities for payload control are investigated. Cost effective system concept options are determined for flight control of the payloads. Implementation guidelines are developed for proposed system concept options. Joint preflight activities are identified. Composite joint resources are identified. Author

N77-15078*# M&S Computing, Inc., Huntsville, Ala.
PAYLOAD SOFTWARE TECHNOLOGY Midterm Report
24 Dec. 1976 84 p refs
(Contract NAS8-32047)
(NASA-CR-150168; Rept-76-0084) Avail: NTIS HC A05/MF A01 CSCL 09B

A software analysis was performed of known STS sortie payload elements and their associated experiments. This provided basic data for STS payload software characteristics and sizes. A set of technology drivers was identified based on a survey of future technology needs and an assessment of current software technology. The results will be used to evolve a planned approach to software technology development. The purpose of this plan is to ensure that software technology is advanced at a pace and a depth sufficient to fulfill the identified future needs. Author

N77-15079*# Hamilton Standard, Windsor Locks, Conn.
BREADBOARD CO2 AND HUMIDITY CONTROL SYSTEM Interim Report
Albert M. Boehm Oct. 1976 178 p
(Contract NAS9-13624)
(NASA-CR-151146; SVHSER-7103) Avail: NTIS HC A09/MF A01 CSCL 22B

A regenerable CO2 and humidity control system is being developed for potential use on shuttle as an alternate to the baseline lithium hydroxide (LiOH)/condensing heat exchanger system. The system utilizes a sorbent material, designated HS-C, to adsorb CO2 and water vapor from the cabin atmosphere. The material is regenerated by exposing it to space vacuum. A half-size breadboard system, utilizing a flight representative HS-C canister, was designed, built, and performance tested to shuttle requirements for total CO2 and total humidity removal. The use of a new chemical matrix material allowed significant optimization of the system design by packing the HS-C chemical into the core of a heat exchanger which is manifolded to form two separate and distinct beds. Breadboard system performance was proven by parametric testing and simulated mission testing over the full range of shuttle crew sizes and metabolic loadings. Vacuum desorption testing demonstrated considerable savings in previously projected shuttle vacuum duct sizing. Author

N77-15080*# Martin Co., Denver, Colo.
PAYLOAD CREW INTERFACE DESIGN CRITERIA AND TECHNIQUES. TASK 1: INFLIGHT OPERATIONS AND TRAINING FOR PAYLOADS
W. D. Carmean and F. R. Hitz 6 Oct. 1976 177 p refs
(Contract NAS9-14676)
(NASA-CR-151152) Avail: NTIS HC A06/MF A01 CSCL 22B

Guidelines are developed for use in control and display panel design for payload operations performed on the aft flight deck of the orbiter. Preliminary payload procedures are defined. Crew operational concepts are developed. Payloads selected for operational simulations were the shuttle UV optical telescope (SUOT), the deep sky UV survey telescope (DUST), and the shuttle UV stellar spectrograph (SUSS). The advanced technology laboratory payload consisting of 11 experiments was selected for a detailed evaluation because of the availability of operational data and its operational complexity. Author

N77-15081*# Chrysler Corp., New Orleans, La. Space Div.
MATED AERODYNAMIC CHARACTERISTICS INVESTIGATION FOR THE 0.04 SCALE MODEL TE 1065 (BOEING 747-100) OF THE 747 CAM AND THE 0.0405 SCALE MODEL (43-0) OF THE SPACE SHUTTLE ORBITER IN THE NASA LANGLEY V/STOL TRANSITION RESEARCH WIND TUNNEL (CA8), VOLUME 1
Oct. 1976 895 p refs
(Contract NAS9-13247)
(NASA-CR-147641; DMS-DR-2290-Vol-1) Avail: NTIS HC A99/MF A01 CSCL 01A

Aerodynamic force data are presented in tables and graphs for the NASA Langley V/STOL Transition Research Wind Tunnel tests on a 0.04 scale model of the 747 with a 0.0405 scale Orbiter space shuttle. The investigation included the effects of flap setting, stabilizer angle, elevator angle, ground proximity, and Orbiter tailcone fairing. Data were obtained in the pitch

plane only. The test was run at M = 0.15, with a dynamic pressure of 35 psf. Six static pressures were measured on each side of the 747 CAM nose to determine the effects of the Orbiter on the 747 airspeed and altitude indicators. Author

N77-15082*# Chrysler Corp., New Orleans, La. Space Div.
MATED AERODYNAMIC CHARACTERISTICS INVESTIGATION FOR THE 0.04 SCALE MODEL TE 1065 (BOEING 747-100) OF THE 747 CAM AND THE 0.0405 SCALE MODEL (43-0) OF THE SPACE SHUTTLE ORBITER IN THE NASA LANGLEY V/STOL TRANSITION RESEARCH WIND TUNNEL (CA8), VOLUME 2
Oct. 1976 784 p refs
(Contract NAS9-13247)
(NASA-CR-147642; DMS-DR-2290-Vol-2) Avail: NTIS HC A99/MF A01 CSCL 01A
For abstract, see N77-15081.

N77-15083*# Chrysler Corp., New Orleans, La. Space Div.
MATED AERODYNAMIC CHARACTERISTICS INVESTIGATION FOR THE 0.04 SCALE MODEL TE 1065 (BOEING 747-100) OF THE 747 CAM AND THE 0.0405 SCALE MODEL (43-0) OF THE SPACE SHUTTLE ORBITER IN THE NASA LANGLEY V/STOL TRANSITION RESEARCH WIND TUNNEL (CA8), VOLUME 3
Oct. 1976 782 p refs 3 Vol.
(Contract NAS9-13247)
(NASA-CR-147643; DMS-DR-2290-Vol-3) Avail: NTIS HC A99/MF A01 CSCL 01A
For abstract, see N77-15081.

N77-15084*# Transemantics, Inc., Washington, D.C.
EUROPEAN UTILIZATION OF THE AMERICAN SPACE TRANSPORT SYSTEM SPACE SHUTTLE
W. vonKries NASA Dec. 1976 20 p refs Transl. into ENGLISH from Zeitschrift fuer Luft- und Weltraumrechts. (W. Germany), v. 25, Mar. 1976 p 15-27
(Contract NASw-2792)
(NASA-TT-F-17505) Avail: NTIS HC A02/MF A01 CSCL 22A

The significance of the space shuttle as a unique low cost space transport system is considered, giving attention to the dependence of Europe on the space shuttle for a utilization of space on a competitive basis. An investigation is, therefore, conducted regarding the legal aspects of a participation of Europeans in the use of the space transport system of the future. Relevant space related agreements between the U.S. and European countries are critically examined, taking into account the regulations concerning the development and manufacture of Spacelab. Author

N77-15085*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
SPACELAB CRYOGENIC PROPELLANT MANAGEMENT EXPERIMENT Special Report, Jun. - Nov. 1976
E. C. Cady Nov. 1976 63 p refs
(Contract NAS3-19719)
(NASA-CR-135143; MDC-G6552) Avail: NTIS HC A04/MF A01 CSCL 22B

The conceptual design of a Spacelab cryogen management experiment was performed to demonstrate toe desirability and feasibility of subcritical cryogenic fluid orbital storage and supply. A description of the experimental apparatus, definition of supporting requirements, procedures, data analysis, and a cost estimate are included. Author

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications*.

N77-15086*# General Electric Co., Philadelphia, Pa. Space Div.
LANDSAT D LOCAL USER TERMINAL STUDY Final Report
L. Alexander, M. Louie, R. Spencer, and W. K. Stow 29 Oct. 1976 78 p
(Contract NAS5-24022)
(NASA-CR-144850; DOC-76SDS4270) Avail: NTIS HC A05/MF A01 CSCL 17B

The effect of the changes incorporated in the LANDSAT D system on the ability of a local user terminal to receive, record and process data in real time was studied. Alternate solutions to the problems raised by these changes were evaluated. A loading analysis was performed in order to determine the quantities of data that a local user terminal (LUT) would be interested in receiving and processing. The number of bits in an MSS and a TM scene were calculated along with the number of scenes per day that an LUT might require for processing. These then combined to a total number of processed bits/day for an LUT as a function of sensor and coverage circle radius. Author

N77-15087# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE 10.6 MICROMETER COHERENT MONOPULSE TRACKING INTERIM RESULTS
Rein Teoste and William J. Scouler 7 May 1976 48 p refs
(Contract F19628-76-C-0002; ARPA Order 600)
(AD-A027209; TN-1976-19; ESD-TR-76-107) Avail: NTIS HC A03/MF A01 CSCL 17/5

The report describes the present status and recent results of 10.6 micrometer monopulse radar tracking experiments. Included is a description of the radar system and results of short range (20 km) and long range (150 km) tracking experiments which show that useful monopulse processing of IR radar returns can be accomplished. The short range experiments involved a stationary test tower and a moving cooperative aircraft. The long range experiment demonstrated, for the first time, 10.6 micrometer coherent monopulse tracking of a satellite. GRA

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics*.

N77-15088*# New Orleans Univ., La. Dept. of Mathematics.
FIRST ORDER IMPULSIVE SOLUTIONS
J. F. Andrus 27 Sep. 1976 19 p refs Backup document for AIAA Synoptic scheduled for publication in AIAA Journal in Apr. 1977
(Contract NAS8-20082)
(NASA-CR-149378) Avail: NTIS HC A02/MF A01 CSCL 22A

A mathematically rigorous derivation is given of first order corrections to multi-impulse approximations to the solutions to space flight optimization problems with bang-bang control. The rocket was subjected to an inverse square gravitational force and to a thrust force with constant magnitude. The mass decreased linearly with time. An optimal impulsive solution was obtained for a problem with given initial and final conditions. The method was then used to obtain first-order corrections to the initial values of the costate variables. Indications are given on how the theory may be extended to higher order corrections. The theory was applied to intercept and rendezvous problems. Author

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

No abstracts in this category.

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

N77-15089*# Aerojet Liquid Rocket Co., Sacramento, Calif.
ANALYSIS OF ROCKET ENGINE INJECTION COMBUSTION PROCESSES Final Report
J. W. Salmon Nov. 1976 190 p refs
(Contract NAS8-31531)
(NASA-CR-150141; Rept-31531-F-1) Avail: NTIS HC A09/MF A01 CSCL 21H

A critique is given of the JANNAF sub-critical propellant injection/combustion process analysis computer models and application of the models to correlation of well documented hot fire engine data bases. These programs are the distributed energy release (DER) model for conventional liquid propellants injectors and the coaxial injection combustion model (CICM) for gaseous annulus/liquid core coaxial injectors. The critique identifies model inconsistencies while the computer analyses provide quantitative data on predictive accuracy. The program is comprised of three tasks: (1) computer program review and operations; (2) analysis and data correlations; and (3) documentation. Author

N77-15090# Hercules, Inc., Cumberland, Md. Allegany Ballistics Lab.
Mk 58 ROCKET MOTOR REMOTE ARM/FIRE DEVICE Final Report, Sep. 1975 - May 1976
15 Jun. 1976 29 p
(Contract N00019-76-C-0126)
(AD-A027682; AO-4066-154-01-002) Avail: NTIS HC A03/MF A01 CSCL 21/8

Contract N00019-76-C-0126 was awarded by NAVAIR to Hercules/ABL with the objective of defining and evaluating remote only type arm and fire mechanisms for application on the surface launched AIM-7F Sparrow. All the program design evaluation and delivery goals were met. A series of four arm/fire devices were designed and evaluated in Phase I with respect to a series of predefined system design specifications and functional requirements. Hercules completed a system rating study of the four devices and recommended two potential systems for the second phase design study. Final selection of an arm/fire device for the Phase II prototype design effort was completed by NAVSEA. The rotary solenoid/pressure sleeve type device was selected based upon potential superior performance of this system under a 40-foot drop environment. GRA

N77-15091# Aerojet Solid Propulsion Co., Sacramento, Calif.
DESIGN AND TEST OF THE OPERATIONAL IN-SITU GAGE FOR SOLID PROPELLANT SURVEILLANCE Final Report, May 1973 - Nov. 1974
Herman P. Briar (Laboratory Automation Services, Rancho Cordova, Calif.), Kenneth W. Bills, Jr., and Richard A. Schapery (Tex. A and M Univ., College Station) Jun. 1976 142 p refs
(Contract F04611-73-C-0040; AF Proj. 3059)
(AD-A027581; ASPC-1064-26-F; AFRPL-TR-76-36) Avail: NTIS HC A07/MF A01 CSCL 21/8

The objective of this program was to develop practical instrumentation hardware for solid rocket motor surveillance. The approach was to reduce to practice existing concepts of grain instrumentation and telemetry using a modular design concept in which each unit consists of a power source/transmitter module, a sensor, and a sensor-to-transmitter interface module. A previous program gave the Duomorph sensor, a device for making in-situ measurements of propellant moduli. The present program made improvements in the Duomorph design plus the development of a modular design for the telemetry units. This latter design permits the use of a wide range of devices for measuring the stress, strain, temperature or dynamic mechanical properties at a point in the grain. This report describes the Duomorph designs, their operation, and the supporting analyses. The telemetry modules are described with respect to their electronic circuits, packaging, installation and operational safety. Laboratory models of the Duomorph sensor have demonstrated a precision of about 2%. Several approaches for improving this precision are discussed. Whether these refinements are needed will depend upon the accuracy required for a given application. Analyses performed to establish the relationship between Duomorph output data and the viscoelastic properties of the continuum are presented. GRA

23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

N77-15092 Case Western Reserve Univ., Cleveland, Ohio.
THE ROLE OF CERTAIN ORGANIC SULFUR COMPOUNDS AS PREVENTIVE ANTIOXIDANTS Ph.D. Thesis
Edward Richard Harrington, Jr. 1976 114 p
Avail: Univ. Microfilms Order No. 76-28389

Product studies performed on the reaction mixtures from the induced decomposition of cumene hydroperoxide by sulfenic acid and thiosulfoxylic acid and/or their oxidation products such as sulfonic acid and thiolsulfuric acid, indicate that both polar and free radical processes are involved. In all cases the polar decomposition predominated. The antioxidant action of sulfenic acids is complex, and probably includes pro-oxidant effects, chain-breaking reactions, chain-transfer reactions, and non-radical hydroperoxide decomposition. The compounds studied were found to be functioning principally as peroxide decomposers by non-radical mechanisms which accounts for their observed activity as preventive antioxidants. Dissert. Abstr.

N77-15093*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE NATURE OF SURFACES AND THEIR INFLUENCE IN WEAR MECHANISMS
Donald H. Buckley [1976] 23 p refs To be presented at the Automotive Engineering Conf., Detroit, 28 Feb. - 4 Mar. 1977; sponsored by the Soc. of Automotive Engineers
(NASA-TM-X-73516) Avail: NTIS HC A02/MF A01 CSCL 11G

The wear of materials is strongly dependent upon the nature of the solid surfaces in contact, their properties and the nature of their films. Oxide films, orientation, crystal transformations, adhesive binding, crystal structure, hardness, and the presence of alloying agents are all shown to affect one or more of the forms of wear. The three most common forms of wear, adhesive, abrasive, and corrosive, are discussed in terms of the way each is affected by various material properties. Results presented indicate how wear can be optimized by concern for properties of materials. Author

N77-15094# Materials Research Labs., Maribyrnong (Australia).
SECOND ORGANIC COATINGS SYMPOSIUM
J. T. Hinde, ed. Aug. 1976 66 p refs Proc. held at Maribyrnong, Australia, 6 Aug. 1975
(MRL-R-671; AR-267) Avail: NTIS HC A04/MF A01

Recent technical developments in paints, the formation of phosphate and chromate conversion coatings, assessment of camouflage systems, factors affecting paint deterioration, and the prevention of fungal growth on paints were discussed. Author

24 COMPOSITE MATERIALS

Includes laminates.

N77-15095 Rensselaer Polytechnic Inst., Troy, N.Y.
THEORY OF COMPOSITES MODELED BY INTERPENETRATING SOLID CONTINUA Ph.D. Thesis
Majid Jahanmir 1976 229 p
Avail: Univ. Microfilms Order No. 76-27196

The differential equations and boundary conditions describing the behavior of composite materials are derived by means of a model of interpenetrating solid continua, which are permitted to displace with respect to each other to produce interaction between them. The equations for two and three constituent composites are obtained, and it is shown that the equations obtained for three-constituent composites can easily be generalized for n-constituent composites. A variational principle is also presented, which is shown to yield the aforementioned system of equations and boundary conditions in the absence of dissipation and heat flow. The equations and boundary conditions for noncontinuous fiber reinforced composites are obtained from the general equations of a two-constituent composite. Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-15096 North Carolina Univ., Raleigh.
ON THE THERMAL EXPANSION OF UNIDIRECTIONAL FIBER COMPOSITES AND REINFORCING GRAPHITE FIBERS Ph.D. Thesis
Khalid Hameed Khan 1976 144 p
Avail: Univ. Microfilms Order No. 76-28494

A formula was proposed for the transverse thermal expansion of unidirectional fiber composites based on the thermal and mechanical properties of the constituents and the arrangement of fibers. In addition, a discrete element method of analysis using a high speed digital computer was developed to calculate the thermal expansion behavior of unidirectional fiber composites. Both methods were compared with experimental determinations. In addition, the transverse thermal expansion behavior and thermal stresses developed during cool down of graphite fibers were analytically evaluated. To augment the theoretical treatment, experiments were carried out on Magnamiter type HMS fibers. A high pressure testing system was designed which could measure thermal expansion as well as compressibility at different temperatures of solids. Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-15097*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUMMARY OF NASA RESEARCH ON THERMAL-BARRIER COATINGS
Francis S. Stepka, Curt H. Liebert, and Stephan Stecura [1977] 27 p refs Proposed for presentation at the Automotive Eng. Conf., Detroit, 28 Feb.-4 Mar. 1977; Sponsored by the SAE (NASA-TM-X-73584) Avail: NTIS HC A03/MF A01 CSCL 11D

A durable, two-layer, plasma-sprayed coating consisting of a ceramic layer over a metallic layer was developed that has the potential of insulating hot engine parts and thereby reducing metal temperatures and coolant flow requirements and/or permitting use of less costly and complex cooling configurations and materials. The investigations evaluated the reflective and insulative capability, microstructure, and durability of several coating materials on flat metal specimens, a combustor liner, and turbine vanes and blades. In addition, the effect on the aerodynamic performance of a coated turbine vane was measured. The tests were conducted in furnaces, cascades, hot-gas rigs, an engine combustor, and a research turbojet engine. Summaries of current research related to the coating and potential applications for the coating are included. Author

DATA SUMMARY: Fatigue tests of uncoated and zirconia thermal-barrier coated turbine vanes and combustor liners; variables include cycles-to-failure; coating thickness, leading edge wall metal temperature, coolant-to-gas flow rate, maximum liner temperature, flame radiation, average exhaust gas temperature; 6 figures and 1 table include numeric data.

N77-15098*# Scientific Translation Service, Santa Barbara, Calif.
STUDY OF THE STRUCTURE OF MOLYBDENUM SULFIDE AND SELENIDE COMPOUNDS. 1: CRYSTAL STRUCTURE OF Mo3Se4
O. Bars, J. Guillevic, and D. Grandjean Washington NASA Nov. 1976 19 p refs Transl. into ENGLISH from J. of Solid State Chem. (France), v. 6, 1973 p 48-57
(Contract NASw-2791)
(NASA-TT-F-17318) Avail: NTIS HC A02/MF A01 CSCL 11D

The crystals of Mo3Se4 are rhomobohedral, space group R 3, with two formula units in a cell: a = 6.658 A, alpha = 91.58 deg. The structure was solved by the heavy atom method and refined by a full matrix least squares program to R = 0.045 for 537 independent reflections. The structure consists of selenium chains parallel to the three axes such as those of metallic selenium, with wide channels running in the three directions. A few channels are occupied by Me6 clusters so that Mo3Se4 can be regarded as a metallic compound. Author

DATA SUMMARY: Theoretical values for centrosymmetric and noncentrosymmetric cases; variables include atoms determining the plane, equations of plane, atom distance to plane, distances, angles, atomic coordinates; 4 tables include numeric data.

N77-15099*# Scientific Translation Service, Santa Barbara, Calif.
CARBON DIAMAGNETISM AND GRAPHITIZATION PROCESS
A. Pacault and H. Gasparoux Washington NASA Dec. 1976 9 p refs Transl. into ENGLISH from Academie des Sciences Compte Rendus, (Paris), series c, v. 264, no. 14, 1967 p 1160-1164
(Contract NASw-2791)
(NASA-TT-F-17323) Avail: NTIS HC A02/MF A01 CSCL 11D

Earlier experimental data on diamagnetic susceptibility, x, of a graphitized pitch coke vs duration, D, of the thermal treatment are examined. The x = f(D) isotherms show a maximum which is more marked, the shorter is D and the higher is the treatment temperature. The x vs D correlation can be established with only one function. Author

DATA SUMMARY: Apparent activation energy is determined; variables include time, magnetic susceptibility; 4 figures include numeric data.

N77-15100*# Transemantics, Inc., Washington, D.C.
A METHOD OF DERIVING STRAIN DIAGRAMS FOR COMPOSITE MATERIALS TAKING INTO ACCOUNT THE STATISTICAL STRENGTH DISTRIBUTION OF THE REINFORCING FIBERS
A. S. Ovchinskiy, I. M. Kop'yev, and N. K. Bilsagayev NASA Aug. 1976 22 p refs Transl. into ENGLISH from Mekhanika Polimerov (Riga, USSR), no. 6, Nov.-Dec. 1975 p 1021-1031
(Contract NASw-2792)
(NASA-TT-F-17142) Avail: NTIS HC A02/MF A01 CSCL 11D

The statistical accumulation of faults in a composite as the result of the destruction of individual fibers is analyzed. A theoretical method for the derivation of strain diagrams in the strain intervals over which destruction of individual fibers occurs is suggested. The mechanical interaction between the fibers and matrix is described by means of the mean stress throughout the defective volumes of the material. The effect of two different strength distribution laws for reinforcing fibers (equiprobable and Weibull) on the form of strain diagrams of composite materials is investigated. Author

DATA SUMMARY: Strain diagrams and statistical distributions; variables include statistical distribution of fiber strength, functions of distribution of fiber strength, functions of accumulation of damage; Young's modulus, stress, strain; 5 figures include numeric data.

N77-15101*# TRW, Inc., Cleveland, Ohio.
PMR POLYIMIDE/GRAPHITE FIBER COMPOSITE FAN BLADES
P. J. Cavano and W. E. Winters 15 Dec. 1976 98 p refs
(Contract NAS3-18939)
(NASA-CR-135113; ER-7821F) Avail: NTIS HC A05/MF A01 CSCL 11D

Ultrahigh speed fan blades, designed in accordance with the requirements of an ultrahigh tip speed blade axial flow compressor, were fabricated from a high strength graphite fiber tow and a PMR polyimide resin. The PMR matrix was prepared by combining three monomeric reactants in methyl alcohol, and the solution was applied directly to the reinforcing fiber for subsequent in situ polymerization. Some of the molded blades were completely finished by secondary bonding of root pressure pads and an electroformed nickel leading edge sheath prior to final machining. The results of the spin testing of nine PMR fan blades are given. Prior to blade fabrication, heat resin tensile properties of the PMR resin were examined at four formulated molecular weight levels. Additionally, three formulated molecular weight levels were investigated in composite form with both a high modulus and a high strength fiber, both as-molded and postcured, in room temperature and 232 C transverse tensile, flexure and short beam shear. Mixed fiber orientation panels simulating potential blade constructions were also evaluated. Flexure tests, short beam shear tests, and tensile tests were conducted on these angle-plied laminates. Author

DATA SUMMARY: Diverse data are presented; variables include tensile strength, modulus, weight loss, flexure strength, shear strength, dimensions, temperature.

N77-15102*# Bendix Research Labs., Southfield, Mich.
FABRICATION AND TEST OF EXPERIMENTAL AUTOMOTIVE FRICTION MATERIALS Final Report, Aug. 1973 - Mar. 1976
Marcel L. Halberstadt May 1976 211 p refs
(Contract NAS2-7758)
(NASA-CR-137852; Rept-8071) Avail: NTIS HC A10/MF A01 CSCL 11D

Three classes of experimental ingredients having good high temperature stability were substituted, singly and in combination, for corresponding ingredients in a standard friction material. The effects of substitution were evaluated by physical and chemical analysis, and principally by determination of friction and wear properties as a function of temperature on a sample drag dynamometer. The major finding was the demonstration of the potential of potassium titanate fiber for the improvement of a friction material of the secondary lining type. For example, the maintenance of a mean friction coefficient of 0.35 between 232 and 343 C (450 and 650 F) was achieved in the presence of the titanate fiber, as opposed to a value of 0.30 in its absence. Wear improvement of the order of 30 to 40% also becomes possible by proper adjustment of resin content and potassium titanate fiber-to-asbestos ratio. Author

DATA SUMMARY: Diverse data are presented; variables include, weight percent, temperature, temperature (corrected for chromel alumel thermocouples), flow rate, coefficient of friction, wear, line pressure, gain, stop number, and thickness wear.

N77-15103*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPOSITE SANDWICH LATTICE STRUCTURE Patent Application
Marvin D. Rhodes and Martin M. Mikulas, Jr., inventors (to NASA) Filed 14 Sep. 1976 26 p
(NASA-Case-Lar-11898-1; US-Patent-Appl-SN-723264) Avail: NTIS HC A03/MF A01 CSCL 11D

A lattice type structural panel is described which utilizes the unidirectional character of filamentary epoxy impregnated composites to produce stiff lightweight structural panels. The panels are suggested for use in constructing large area panels for space satellites. NASA

DATA SUMMARY: Properties of composite panels; variables include mass, lattice spacing, bending stiffness; 3 figures include numeric data.

N77-15104# Materials Research Labs., Maribyrnong (Australia).
ENVIRONMENTAL EFFECTS ON THE MECHANICAL PROPERTIES OF HIGH PERFORMANCE FIBRES
J. R. Brown and N. M. Browne Aug. 1976 24 p refs
(MRL-R-674; AR-275) Avail: NTIS HC A02/MF A01

Some environmental effects on the mechanical properties of the high performance fibers PBI, Nomex and Kevlar 49 are discussed. Thermal stabilities are given in terms of the changes in mechanical properties such as tensile strength, elongation at break and energy to break after thermal aging at various elevated temperatures in inert and oxidizing conditions. The effects of exposure to sunlight and ionizing radiation are shown by similar measurements. The dimensional stability of the fibers at elevated temperatures and the effects of thermal aging, exposure to sunlight and ionizing radiation on the flammability properties of PBI and Nomex are discussed. Author

DATA SUMMARY: Mechanical properties of synthetic fibers before and after various environmental tests; variables include elongation at break, energy to break, tensile strength, aging period, thermal shrinkage, breaking force; 7 figures and 2 tables include numeric data.

N77-15105*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPRAYABLE LOW DENSITY ABLATOR Patent Application
Max H. Sharpe, William E. Hill, William G. Simpson, James M. Carter, Edwin L. Brown, Harry M. King, Paul H. Schuerer, and David D. Webb, inventors (to NASA) Filed 19 Jan. 1977 24 p
(NASA-Case-MFS-23506-1; US-Patent-Appl-SN-760809) Avail: NTIS HC A02/MF A01 CSCL 11D

A sprayable, low density ablative composition is described. The composition consists of: (1) 100 parts by weight of a mixture of 25-65% by weight of phenolic microballoons, 0-20% by weight of glass microballoons, 4-10% by weight of glass fibers, 25-45% by weight of an epoxy-modified polyurethane resin, 2-4 by weight of a benetonite dispersing aid and 1-2% by weight of an alcohol activator for the bentonite. NASA

DATA SUMMARY: Formulation of the ablative coating; variables include % weight, parts per hundred; 2 tables include numeric data.

N77-15106# Delaware Univ., Newark. Dept. of Mechanical and Aerospace Engineering.
ACOUSTIC EMISSION RESPONSE OF METAL MATRIX COMPOSITES Final Report
R. Byron Pipes, N. J. Ballintyn, and William R. Scott 23 Jan. 1976 56 p refs
(Contract N62269-75-C-0103; WR02201001)
(AD-A026024; NADC-76082-30) Avail: NTIS HC A04/MF A01 CSCL 11/4

This program investigates acoustic emission techniques for nondestructive evaluation of the integrity of a boron-aluminum composite material. The influence of biaxial states of stress upon the acoustic response of the composite material is examined through implementation of a test program which utilizes the off-axis tensile coupon specimen. Both mechanical property and acoustic emission test results are presented. Author (GRA)

DATA SUMMARY: Tensile tests of boron-aluminum composites; variables include shear coupling ratio, angles, stress, strain, acoustic emission count rate; 22 figures include numeric data.

N77-15107# Dayton Univ. Research Inst., Ohio. Research Inst.
SIGNIFICANT PROPERTIES OF EPOXY RESINS AS MATRICES IN GRAPHITE COMPOSITES Technical Report, Apr. 1970 - Dec. 1971
Ronald J. Kuhbander and N. J. Pagano Wright-Patterson AFB, Ohio AFML Mar. 1976 96 p refs
(Contract F33615-72-C-1620; AF Proj. 7340)
(AD-A026028; AFML-TR-70-305-Pt-2) Avail: NTIS HC A05/MF A01 CSCL 11/4

It is desirable, for purposes of developing better resins, to know what properties of thermosetting resins are most significant

in affecting the structural properties of grahphite fiber/resin matrix composites. Unidirectional and multidirectional composites were fabricated and evaluated using five resin matrix systems. The influence of these resin properties on composite performance was examined through the experimental evaluation of composites fabricated from several resin materials possessing rather widely varying mechanical properties. Composite properties measured include: initial modulus, proportional limit, and ultimate strength. GRA

DATA SUMMARY: Properties of cast resins, longitudinal composites, transverse composites, and three types of multidirectional composites; variables include fiber properties, mean value, standard deviation, tensile load, strain, stress, solution surface tension, cast ultimate tensile strength, tension, and torsion; 10 figures and 7 tables include numeric data.

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

N77-15108 Engineering Sciences Data Unit, London (England).
THERMAL CONDUCTIVITY OF LIQUID n-ALKYL ESTERS OF MONOBASIC n-ALKANOIC ACIDS
Aug. 1976 25 p
(ESDU-76017; ISBN-0-85679-153-9) For information on availability of series, sub-series and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161. HC $290.50

Values of thermal conductivity at saturation pressure are presented in tabular form, for the liquid normal alkyl esters of monobasic normal alkanoic acids which are members of the following groups: formates, acetates, propionates, butyrates, valerates, hexanoates, heptanoates, octanoates, decanoates, laurates, myristates, palmitates, and stearates. The data on which these recommended values of thermal conductivity are based are the most reliable available and the range covered is from the melting point to approximately 0.9 of the critical temperature. The procedure used to obtain the values of thermal conductivity presented is described. The effect of pressure is discussed.
Author

N77-15109 Oregon Univ., Eugene.
PULSED LASER RAMAN SPECTROSCOPY Ph.D. Thesis
Chenning Chu 1976 97 p
Avail: Univ. Microfilms Order No. 76-27635

An electronic high speed Raman spectrograph was constructed. Some of the advantages were traded off by using a double monochromator to eliminate most of the scattering radiations. An image intensifier was used to amplify the optical spectrum before it was focused on the photocathode of a silicon intensified target camera tube. After it was converted, amplified and processed, the optical spectrum was then displayed on an oscilloscope. A power ruby laser, both in normal mode, and Q-switched was used to do most of the studies. A dye laser, with a 0.6 microseconds duration, also aligned with the system was used to do some resonance Raman studies. Spectra of toluene, AMP, GMP, lysozyme, t-RNA, phenantholine were recorded by one or more flashes and are presented. A micro temperature-jump cell was designed and constructed.
Dissert. Abstr.

N77-15110 State Univ. of New York, Buffalo.
CRYSTAL GROWTH AND PHASE TRANSFORMATION ON THE CALCIUM SULFATE HYDRATES IN AQUEOUS SOLUTION AT ELEVATED TEMPERATURES Ph.D. Thesis
Felix Shingmin Tsai 1976 169 p
Avail: Univ. Microfilms Order No. 76-26571

A specialized autoclave was constructed which can be used at temperatures up to 150 C. The crystallization of calcium sulfate dihydrate was studied extending up to 105 C at which phase transformation to the hemihydrate occurs. The reaction rate was proportional to the square of the relative supersaturation. An approximately constant number of growth sites were found available during the crystallization experiments. Crystal growth of calcium sulfate hemihydrate was also studied at temperatures from 100 to 130 C. The kinetics of the reaction was complicated by the accompanying phase transition between not only alpha and beta-hemihydrate, but also hemihydrate and anhydrite. The organic phosphonate, diethylenetriaminepentamethylene phosphonic acid (DENPMP), showed a remarkable inhibiting effect on the growth of either calcium sulfate dihydrate at 90 C or the hemihydrate at 120 C. Dissert. Abstr.

N77-15111 Rutgers Univ., New Brunswick, N.J.
MOESSBAUER AND RAMAN SPECTROSCOPY OF ORGANO-TIN COMPOUNDS Ph.D. Thesis
Michael Francis Leahy 1976 167 p
Avail: Univ. Microfilms Order No. 76-27015

Raman and Mossbauer spectroscopic studies were carried out on a number of organic compounds of tin. It is shown that it is possible to identify a lattice vibration in the Raman spectrum at low frequencies which corresponds to an intermolecular, intra-unit cell motion of two molecules against each other. This correlation was extended to molecules in which the tin atom or atoms do not occupy the position of the center of mass. In the study of low melting, low molecular weight compounds, e.g., tetramethyltin, tetrabenzyltin, tin (4) hydride, and tin (4) deuteride, it was discovered that the temperature dependence of the recoil free fraction does not reach a linear high temperature limit. By assuming that anharmonic effects would be negligible at temperatures below half the characteristic lattice temperature, a self consistent assignment of a Raman active mode to the anti-translational motion of half the molecules in the unit cell against the other half can be made. Dissert. Abstr.

N77-15112 Michigan Univ., Ann Arbor.
EXPLODING WIRES AS AN INTENSE CONTINUUM EXCITATION SOURCE FOR FLAME AND FLAMELESS ATOMIC FLUORESCENCE SPECTROMETRY Ph.D. Thesis
Dennis William Brinkman 1976 211 p
Avail: Univ. Microfilms Order No. 76-27457

Metallic wires exploded by capacitive discharge produced very intense continuum radiation extending from 200 to 400 nm. The radiation from the explosion persisted for about 100 microseconds. The peak absolute irradiance was several orders of magnitude higher than the commonly used xenon arc. The intensity of the emitted radiation was dependent on many variables including wire size, electrical parameters of the power source, and pressure and composition of the ambient atmosphere. The continuum intensity increased linearly with stored energy on the capacitor bank and with decreasing wire diameter. Although the continuum intensity was not significantly dependent on wire material, it was very dependent on the pressure and composition of the surrounding gas. Increasing pressure resulted in a nearly linear increase in intensity up to about one atmosphere, after which little or no change was observed. Dissert. Abstr.

N77-15113 California Univ., Davis.
AN ELECTROLYTIC CONDUCTIVITY DETECTOR FOR HIGH SPEED LIQUID CHROMATOGRAPHY Ph.D. Thesis
John Wiggin Dolan 1976 129 p
Avail: Univ. Microfilms Order No. 76-28965

An electrolytic conductivity detector (ECD) for high speed liquid chromatography (HSLC) which is sensitive to chlorine-containing compounds was developed. It exhibited a certain degree of selectivity in response to chlorinated compounds in the presence of non-chlorinated compounds. Samples were separated on a C18 reversed phase HSLC column and detected with a modified Coulson electrolytic conductivity detector for GC. The column effluent was introduced into a 4 mm i.d. quartz combustion tube where the sample was reductively pyrolyzed in the presence of hydrogen at 850 to 950 deg. The combustion products, mainly HCl, were then dissolved in an aqueous methanol solution and detected by monitoring the conductivity of the solution with a Wheatstone bridge circuit. Dissert. Abstr.

N77-15114 Minnesota Univ., Minneapolis.
ANALYSIS AND CHARACTERIZATION OF NOISE IN FLAME SPECTROSCOPY Ph.D. Thesis
Willard Arnold Hareland 1976 178 p
Avail: Univ. Microfilms Order No. 76-27803

Power density spectra of flame spectrometry signals in the frequency range from 2 mHz to 500 Hz were measured and studied. Results indicate that the flame is the major source of noise in analytical flame emission and atomic absorption spectrometry. The noise spectra of optical signals from diffusion and premixed total consumption flames are similar. Below 1 Hz, 1/f-type noise predominates in dry and humidified acetylene flame signals. Between 1 Hz and 100 Hz, the noise power density is constant and independent of frequency. In the 100 to 500 Hz region, the noise spectra of humidified flame signals show a broad peak which is absent in the corresponding dry flame noise spectra. The frequency distribution and the relative magnitude of the solvent-dependent noise varies with the solvent uptake rate and the observation point in the flame. The procedure for the measurement of noise spectra is discussed. Dissert. Abstr.

N77-15115 Louisville Univ., Ky.
A DIGITAL CHEMICAL MULTIMETER USING AMPLITUDE MODULATION ANALOG CONVERSION Ph.D. Thesis
Gary Harold Revlett 1976 186 p
Avail: Univ. Microfilms Order No. 76-26204

A digital data acquisition system is described which is capable of obtaining data using six different input functions. These are pH, voltage, resistance, conductance, absorbance, and temperature. In addition to a digital display the data can be output via a printer, paper tape punch, programmable calculator, or a remote teletype terminal. The usefulness, reliability, and versatility of the instrument is demonstrated in a series of tests and chemical experiments. The instrumental tests include measurement of short and long term stability, linearity and temperature dependence. Chemical experiments conducted are: (1) detection of dehydration reactions; (2) determination of dissociation constant of pH indicator; (3) observations on the oscillating reaction of potassium bromate, ceric sulfate, and malonic acid; and (4) routine stream monitoring. Dissert. Abstr.

N77-15116 Yale Univ., New Haven, Conn.
LASER INDUCED SPECTROSCOPY OF MOLECULAR IONS Ph.D. Thesis
Paul Craig Engelking 1976 99 p
Avail: Univ. Microfilms Order No. 76-29197

An apparatus consisting of a nitrogen laser-pumped dye laser, a flowing afterglow, and a gated photoelectric detection system, collected spectra of molecular ions. The design and construction of a Blumlein nitrogen laser working at 337.1 mm was presented. Its performance characteristics compare well with other designs and it adequately pumps a dye laser constructed for the generation of tunable visible and near ultraviolet radiation. The dye laser used a diffraction grating and a spectrometer grating drive to achieve a linear wavelength scan and an intracavity telescope to narrow the output bandwidth. The flowing afterglow prepared ions for observation by the reaction of neutral molecules with inert gas metastables formed by a direct current discharge. The dye laser excited the ion species, which subsequently fluoresced. A gated photomultiplier collected the emission from the ions and wavelength tuning of the exciting laser light generated a spectrum. Dissert. Abstr.

N77-15117 Florida State Univ., Tallahassee.
INTERMOLECULAR PERTURBATION OF MOLECULAR POTENTIALS Ph.D. Thesis
Harold Barrett Dellinger 1976 151 p
Avail: Univ. Microfilms Order No. 76-28607

Kinetic discussions of solvent cage effects in photochemistry, and quantum mechanical discussions of potential term perturbations are presented. A catalogue of molecular potentials and some specific cases of solvent perturbations are examined. Predictions are made as to how these solvent cage effects manifest themselves spectrally. The case of the hydrogen-bond repulsive potential was examined experimentally for 4-methylcinnoline and 9,10-diazophenanthrene hydrogen-bonded complexes with perfluoro-t-butanol. A separation of temperature and viscosity effects revealed no intrinsic stabilization of the excited state hydrogen bond, but a viscosity dependent barrier arose which reached a limiting value of about 1,000 cm to the minus 1 power in 3-methylpentane of 77 K. Dissert. Abstr.

N77-15118*# Kanner (Leo) Associates, Annapolis, Md.
STUDY OF LUMINESCENCE OF OH (A-2 SIGMA (+)) RADICAL PRODUCED IN PHOTOLYSIS OF WATER VAPOR BY VACUUM UV RADIATION
I. P. Vinogradov and F. I. Vilesov Washington NASA Jan. 1977 10 p refs Transl. into ENGLISH from Opt. Spektrosk. (USSR), v. 40, no. 1, 1976 p 58-62
(Contract NASw-2790)
(NASA-TT-F-15769) Avail: NTIS HC A02/MF A01 CSCL 07D

The absolute values of quantum yield of luminescence of an excited hydroxyl radical formed upon photolysis of water vapor in the 1370-850 A spectral area are determined. It is established that the luminescence damping rate constant of the OH radical is independent of the energy of the excited photon. Luminescence spectra of the hydroxyl radical are produced. An increase is found in the rotary excitation of the OH radical with a decrease in the wavelength of the exciting radiation. Author

N77-15119*# Kanner (Leo) Associates, Redwood City, Calif.
VERY HIGH RESOLUTION STUDY OF THE TRANSITION B-2 SIGMA + TO A-2 SIGMA + OF OH AND OD USING A HIGH FREQUENCY SOURCE DESIGNED FOR THE PURPOSE
J. Czarny and P. Felenbok Washington NASA Jan. 1977 30 p refs Transl. into ENGLISH of Ann. Astrophys. (Paris), v. 31, no. 1, 1968 p 1-12
(Contract NASw-2790)
(NASA-TT-F-17372) Avail: NTIS HC A03/MF A01 CSCL 07D

Using a water vapor jet excited by high frequency, a very high resolution study was made of the spectrum of the B2 sigma + to A2 sigma + system of OH and OD. The doublet structures from the head on are resolved, and the intensity of both components is given. The satellite line P(Q sub 1,2) and the following perturbations were observed: (1) change of gamma sign between v' = 5 and v' = 6; (2) rotational lines half-width variation for the 0.8, 0.7, 0.6 bands; and (3) increase of the half-width for K equal to or greater than 6 in the 0.8 band of OH. Author

N77-15120# Sandia Labs., Albuquerque, N.Mex.
DETERMINATION OF THE SOLID-LIQUID-VAPOR TRIPLE POINT PRESSURE OF CARBON
David M. Haaland Jan. 1976 45 p refs
(Contract AT(29-1)-789)
(SAND-76-0074) Avail: NTIS HC A03/MF A01

A detailed experimental study of the triple point pressure of carbon using laser heating techniques was completed. Uncertainties and conflict in previous investigations were addressed and substantial data presented which places the solid-liquid-vapor carbon triple point at 107 + 2 atmospheres. This is in agreement with most investigations which have located the triple point pressure between 100 and 120 atmospheres, but is in disagreement with recent low pressure carbon experiments. The absence of any significant polymorphs of carbon other than graphite suggests that the graphite-liquid-vapor triple point was measured. Graphite samples were melted in a pressure vessel using a 400 W Nd:YAG continuous-wave laser focused to a maximum power density of approximately 80 kW/sq cm. Melt was confirmed by detailed microstructure analysis and X-ray diffraction of the recrystallized graphite. ERA

N77-15121# Naval Research Lab., Washington, D.C. Strength of Metals Branch.
IGNITION OF FLAMMABLE GASES IN CRUDE-OIL TANKERS AS A RESULT OF METAL FRACTURE Final Report
W. A. Affens and E. A. Lange 29 Jun. 1976 15 p refs
(NRL Proj. C01-03A)
(AD-A027411; NRL-8013) Avail: NTIS HC A02/MF A01 CSCL 13/12

A literature search and an energy analysis have shown that the energies generated and the temperatures developed by metal

fracture are not sufficient to ignite a flammable mixture of hydrocarbon vapor and air directly. It was concluded from this study that if metal fracture were to be a cause of ignition, it would be by an indirect process. The most likely cause of ignition resulting from metal fracture would be due to frictional impact or friction of fractured metal structural members with each other or with other objects. It was also concluded that normal impact (without friction) or single rubbings would not generate sufficient energy for ignition unless friction sparks also resulted. Friction sparks are more likely to cause ignition if highly pyrophoric metals are present. It was also concluded that adiabatic compression is a possible source of ignition in the case of ship collisions.
Author (GRA)

N77-15122# Naval Civil Engineering Lab., Port Hueneme, Calif.
FUNGAL-RESISTANT ORGANOTIN RESINS Final Report, May 1974 - Jun. 1976
Marcus D. Steele and Richard W. Drisko Jun. 1976 17 p refs
(YR0412601)
(AD-A026190; CEL-TN-1439) Avail: NTIS HC A02/MF A01 CSCL 11/3

A series of alkyd resins were prepared that had tin chemically bonded to them. These resins had more resistance to fungal growth than did the original alkyd resins from which they were prepared. This resistance does not appear to be lost as readily by leaching with rain as that of a resin to which bis(tri-n-butyltin) oxide is added as a preservative. GRA

N77-15123# Illinois Univ., Urbana-Champaign. Roger Adams Lab.
NEW CHEMICAL LUMINESCENT REACTION SYSTEMS. LIGHT FORMATION FROM THE REACTION OF A VICINAL Di-ACID CHLORIDE
Gary B. Schuster 9 Aug. 1976 15 p refs Submitted for publication
(Contract N00014-76-C-0745; NR Proj. 051-616)
(AD-A028632; TR-01) Avail: NTIS HC A02/MF A01 CSCL 07/4

Relatively efficient chemiluminescence was observed from the reaction of 3,6-diphenyl-3,5-cyclohexadiene-1,2-trans-dicarboxylic acid chloride with diisopropylethylamine and hydrogen peroxide in THF. The chemically formed electronically excited state was identified by spectral comparison and lifetime studies as that of p-terphenyl singlet. The yield of excited states was determined to be ca. 2 + or - 1%. Energy transfer from the first formed excited state to various acceptors was possible. It was demonstrated that singlet oxygen was not responsible for the observed chemiluminescence. The intermediacy of a cyclic diacyl peroxide in the chemielectronic step is considered.
Author (GRA)

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N77-15124 Rensselaer Polytechnic Inst., Troy, N.Y.
THE EFFECT OF AUSTENITE STACKING FAULT ENERGY AND AUSTENITE STRENGTH ON THE MORPHOLOGY OF MARTENSITE IN Fe-Ni-Cr-0.3C STEELS Ph.D. Thesis
Martin John Carr 1976 121 p
Avail: Univ. Microfilms Order No. 76-27187

A series of alloys was designed to exhibit a wide range of austenite stacking fault energy maintaining constant M sub s temperature, carbon content, and austenite grain size. The austenite yield strength was not pruposefully controlled in this series. The morphologies were characterized by optical microscopy, and transmission electron microscopy (bright and darkfield). Habit planes were determined by single surface trace analysis. The austenite 0.2% yield strengths were determined by extrapolating sigma sub y vs. T data down to the M sub s; M sub s temperatures were obtained by electrical resistivity measurements. The results indicate that the morphology transition from plate martensite to lath martensite observed in this alloy series results from the decrease in austenite stacking fault energy. Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-15125 Wisconsin Univ., Madison.
KINETIC TRANSITORY GRAIN REFINEMENT IN ALUMINUM AND ITS ALLOYS AND ITS RELATION TO THE HETEROGENEOUS NUCLEATION MECHANISM Ph.D. Thesis
Ronald M. Kotschi 1976 297 p
Avail: Univ. Microfilms Order No. 76-20119

It was determined that grain refinement was not stable after a given boron and/or titanium treatment. After a given refining alloy addition the resulting refinement is seen to decrease with time at temperature. This nonstable grain refinement is termed Kinetic Transitory Grain Refinement or the KTR effect. Tests conducted with hyperperitectic compositions showed that the KTR effect did not fade to zero grain refinement as in the hypoperitectic composition tests. The asymptotes were shown to correlate with the presence of the intermetallic Al3Ti particle. It is concluded that the KTR effect must also be in some way linked to the presence of Al3Ti particles. In order to test this hypothesis, a special 6% titanium alloy was prepared which contained fairly large intermetallic Al3Ti particles. The results of this test supported the contention that the KTR effect was related to the presence of undissolved Al3Ti particles. Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-15126 Rensselaer Polytechnic Inst., Troy, N.Y.
THE INFLUENCE OF AUSTENITE PRESTRAIN ABOVE THE M SUB d TEMPERATURE ON THE MARTENSITIC TRANSFORMATION IN Fe-Ni-Cr-C ALLOYS Ph.D. Thesis
James Richard Strife 1976 117 p
Avail: Univ. Microfilms Order No. 76-27211

The effect of austenite prestrain above the M sub d temperature on the structure and transformation kinetics of the subsequent martensitic transformation observed on cooling was determined for a series of Fe-Ni-Cr-C alloys. The alloys were designed to exhibit a shift in martensite morphology in the nondeformed state from twinned plate to lath while maintaining constant M sub s temperature, carbon content, and austenite grain size. This was accomplished by varying the relative amounts of nickel and chromium. The transformation behavior was observed over the temperature range 0 C to -196 C as a function of tensile prestrains performed above the M sub d temperature. A range of prestrains from 5% to 45% was investigated.
Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-15127 Rutgers Univ., New Brunswick, N.J.
THE INFLUENCE OF AGING AND THERMOMECHANICAL TREATMENTS ON THE FATIGUE PROPERTIES OF AN Al-6.5 AT .% Zn ALLOY Ph.D. Thesis
Mou-Chih Lu 1976 112 p
Avail: Univ. Microfilms Order No. 76-27021

The effects produced by various aging and thermomechanical treatments (TMT) on microstructural and fatigue properties were investigated. The aging treatments included the formation of G.P. zones without and with Zn precipitates of varying size and average interparticle distance. The TMT consisted of either precycling at room temperature or of tensile deformation at elevated temperature followed by aging. Each treatment was designed so that the yield stress tested prior to fatigue cycling was identical. It was found that the TMT was most effective in producing optimum fatigue properties. TMT generated microstructures were characterized by a total absence of precipitation-free zones (PFZ) near grain boundaries and in the interior of the grains and by a uniform distribution of precipitates and dislocations which, upon cycling, generally remained uniform. Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-15128 Maryland Univ., College Park.
BIOTRANSFORMATION OF METALS Ph.D. Thesis
Calvin Windell Huey 1976 111 p
Avail: Univ. Microfilms Order No. 76-27395

Evidence was obtained for the methylation of tin(IV) by a tin and mercury tolerant strain of Pseudomonas isolated from the Chesapeake Bay. Growth of this organism in the presence of both Hg(II) and Sn(IV) results in the formation of methylmercury. A postulated mechanism to account for this formation is: Sn(IV) - Methyltin Species (Biological Pathway) Methyltin Species + Hg(+2) - MeHg(+)(Abiotic Reaction). A mercury-tolerant strain of Pseudomonas, isolated from the Chesapeake Bay, was demonstrated to tolerate Sn(IV), Sn(II), and Cd(II). In the presence of Hg(II) salts, incorporated into Nelson's agar medium, elemental mercury was produced by the organism. On this medium containing Sn(IV), the organism generated a volatile methylated tin species. Vitamin B12, shown to be involved in the methylation of Hg(II) and Sn(IV)/Sn(II) via its CH3-B12 form, was found to stimulate the volatilization of cadmium by Pseudomonas sp. from Cd(II). Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-15129*# Scientific Translation Service, Santa Barbara, Calif.
M SUB xMo3Se4 (M = METAL) PHASES ASSUMING MOLYBDENUM SELENIDE Mo3Se4 AS THE HOST STRUCTURE
M. Sergent and R. Chevrel Jan. 1977 8 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci., Ser. C (Paris), vol. 274, no. 24, 1972 p 1965-1967
(Contract NASw-2791)
(NASA-TT-F-17365) Avail: NTIS HC A02/MF A01 CSCL 11F

The lattice parameters and magnetic susceptibilities (at 80-600 K) were determined for the 3 types of new phases MxMo3Se4 (Z = 2) where the M atoms are essentially distributed in the tunnel structure of Mo3Se4: a rhombohedral structure, isotypical with Mo3Se4, for M = Zn, Cd, Ag, Sn, and Pb with x = 0.6; a trinclinic structure for the continuous solid solutions of insertion for M = Ti, V, Cr, Mn and Fe with x = 0.5-0.7; a rhombohedral structure for the continuous solid solutions of insertion for M = Cu (x = 0-1.4), Co(III) (z = 0-0.7; paramagnetic), and Ni (x = 0-0.8). Author

DATA SUMMARY: Variation of the lattice parameters of phases of CuxMo3Se4 and NixMo3Se4; variable includes lattice parameters; 2 figures include numeric data.

N77-15130*# Kanner (Leo) Associates, Redwood City, Calif.
CREEP IN SINGLE-CRYSTALLINE SILVER IN THE 1.5 TO 300 K TEMPERATURE RANGE
V. A. Koval, V. P. Soldatov, and V. I. Startsev Washington NASA Jan. 1977 14 p refs Transl. into ENGLISH from Fiz. Nizkikh Temperatur (USSR), v. 1, no. 3, 1975 p 368-374
(Contract NASw-2760)
(NASA-TT-F-17377) Avail: NTIS HC A02/MF A01 CSCL 11F

The temperature effects on transient creep in single crystalline silver were studied in the range 1.5 to 300 K. Quantum fluctuations are shown to play a decisive role for the creep process in Ag below 20 K while thermal fluctuations are important at higher temperatures. Low temperature creep was found to be influenced by work hardening. Author

DATA SUMMARY: Some creep parameters dependent on deforming stress; variables include temperature dependence, coefficient of logarithmic creep, strain hardening coefficient, activation volume, deforming stress; 5 figures include numeric data.

N77-15131*# Scientific Translation Service, Santa Barbara, Calif.
NEW TERNARY SULFIDE PHASES OF MOLYBDENUM
R. Chevrel, M. Sergent, and J. Prigent Washington NASA Nov. 1976 14 p refs Transl. into ENGLISH from J. of Solid State Chemistry (France), v. 3, 1971 p 515-519
(Contract NASw-2791)
(NASA-TT-F-17322) Avail: NTIS HC A02/MF A01 CSCL 11F

The preparation of new sulfides of formula M11Monsn+l is described. If M = Ag, Sn,Ca,Sr,Pb,Ba, they are stoichiometric; if M = Ni, Co, Fe,Cr,Mn,Cu, Mg,Zn,Cd, solid solutions are observed with C n 6. Another series of formula M2Monsn+l was also prepared, where M = alkali metal and n = 2 or 5. The crystallographic properties are investigated: the phases obtained are generally rhombohedral, with an eventual triclinic distortion. Author

DATA SUMMARY: X-ray diffractions of various sulfides of molybdenum; variables include interplanar distances, rhombohedral and hexagonal indexes, observed density, calculated density; 2 figures and 2 tables include numeric data.

N77-15132# Materials Research Labs., Maribyrnong (Australia).
CRITERIA FOR THE SELECTION OF HOMOGENEOUS METAL ARMOUR
R. L. Woodward Sep. 1976 16 p refs
(MRL-R-675; AR-279) Avail: NTIS HC A02/MF A01

A method is described which allows an assessment of the relative numerical values for thickness, weight and cost of homogeneous metal armor to defend a unit area against nondeforming, armor piercing type projectiles. The mode of failure described by the model is ductile hole formation, and acceptable results are also obtained if failure is by dishing or plugging. Typical data are presented for a variety of prospective materials and criteria for the choice of appropriate armor are discussed. The superior ballistic performances of titanium alloys and Hadfield's steel are highlighted. Author

DATA SUMMARY: Eight homogenous armor materials are compared, including steels, aluminum alloys, and titanium alloys; variables include hardness, strength, cost, thickness factor, weight factor, areal density; 3 tables include numeric data.

N77-15133*# Martin Marietta Aerospace, Denver, Colo.
DETECTION OF TIGHTLY CLOSED FLAWS BY NONDESTRUCTIVE TESTING (NDT) METHODS IN STEEL AND TITANIUM Final Report, Jul. 1975 - Sep. 1976
Ward D. Rummel, Richard A. Rathke, Paul H. Todd, Jr., Thomas L. Tedrow, and Steve J. Mullen Sep. 1976 109 p refs
(Contract NAS9-14653)
(NASA-CR-151098; MCR-76-476) Avail: NTIS HC A06/MF A01 CSCL 11F

X-radiographic, liquid penetrant, ultrasonic, eddy current and magnetic particle testing techniques were optimized and applied to the evaluation of 4340 steel (180 KSI-UTS) and 6Al-4V titanium (STA) alloy specimens. Sixty steel specimens containing a total of 176 fatigue cracks and 60 titanium specimens containing a total of 135 fatigue cracks were evaluated. The cracks ranged in length from .043 cm (0.017 inch) to 1.02 cm (.400 inch) and in depth from .005 cm (.002 inch) to .239 cm (.094 inch) for steel specimens. Lengths ranged from .048 cm (0.019 inch) to 1.03 cm (.407 inch) and depths from 0.010 cm (.004 inch) to .261 cm (0.103 inch) for titanium specimens. Specimen thicknesses were nominally .152 cm (0.060 inch) and 0.635 cm (0.250 inch) and surface finishes were nominally 125 rms. Specimens were evaluated in the 'as machined' surface condition, after etch surface and after proof loading in a randomized inspection sequence. Author

DATA SUMMARY: Crack characteristics in steels, aluminum alloys, and titanium alloys; variables include thickness, crack depth, crack length, amplitude response, incident angle, detection probability, and crack position; 19 figures and 11 tables include numeric data.

N77-15134# Sandia Labs., Albuquerque, N.Mex.
HYDROGEN COMPATIBILITY OF STRUCTURAL MATERIALS FOR ENERGY STORAGE AND TRANSMISSION APPLICATIONS Semiannual Report
S. L. Robinson, comp., A. J. West, comp., and H. J. Saxton, comp. 15 Jan. 1976 31 p refs
(Contract AT(29-1)-789)
(SAND-76-8206) Avail: NTIS HC A03/MF A01

Work on the hydrogen compatibility of structural materials for pressure vessels and pipelines is proceeding along several

fronts. The tensile behavior of a number of carbon and pressure vessel steels in high pressure hydrogen gas and in contact with iron-titanium hydride was characterized. Slow crack growth studies of pressure vessel steels are nearing completion. Studies addressing the protective value of brush electroplated coatings are being continued. A new silicon coating applied by vapor deposition is also under study. Self-loaded tensile specimens are being prepared in an in-situ accelerated test program. Efforts are underway to modify the hydrogen compatibility of manganese-carbon and high carbon steels by thermomechanical treatment, and to characterize their mechanical properties and microstructures. The effects of chemical segregation on hydrogen cracking are also being studied. Construction of the experimental hydrogen pipeline is proceeding satisfactorily with initial safety tests to be performed soon. ERA

DATA SUMMARY: A516 and A106 were exposed to FeTiHx and 1 atm H2 gas; variables include tensile tests, yield strength, ultimate strength, ductility, uniform elongation, total elongation, permeability, warm rolling, Sn-Pb coatings, brush electroplated coatings; 2 figures and 3 tables include numeric data.

N77-15135# Sandia Labs., Albuquerque, N.Mex.
LOW ENERGY HELIUM IMPLANTATION OF ALUMINUM
K. L. Wilson and G. J. Thomas Feb. 1976 21 p refs Presented at 2d Intern. Conf. on Surface Effects in Controlled Fusion Devices, San Francisco, 16 Feb. 1976
(Contract AT(29-1)-789)
(SAND-75-8760; Conf-760209-26) Avail: NTIS HC A02/MF A01

A series of 20 keV He(+) implantations was conducted on well-annealed MARZ grade aluminum at fluxes of 6 x 10 to the 14th power and 6 x 10 to the 13th power He(+)/sq cm sec. Three distinct, temperature dependent He release mechanisms were found by He re-emission measurements during implantation, and by subsequent SEM and TEM investigations. At 0.08 of the melting temperature (T/sub m/) gas re-emission rose smoothly after a critical dose with extensive blistering. The intermediate temperature range (approximately 0.3 T/sub m/) was characterized by repeated flake exfoliation and bursts of He. Rapid He evolution, with hole formation, was found above 0.7 T/sub m/. No significant differences in either gas re-emission or surface deformation were found between the two fluxes employed. ERA

DATA SUMMARY: Characteristics of He(+) implant in aluminum for 10 samples; variables include re-emission rate, fluence, implant temperature, flux, critical fluence, release rate at end of implant, and surface deformation; 1 figure and 1 table include numeric data.

N77-15136# California Univ., Livermore. Lawrence Livermore Lab. W. M. Keck Lab. of Engineering Materials.
APPROACH TO FERROMAGNETISM IN AMORPHOUS Ni-P-B ALLOYS
A. Amamou and J. Durand Mar. 1976 16 p refs
(Contract AT(04-3)-822)
(CALT-822-81) Avail: NTIS HC A02/MF A01

Magnetization was measured between 1.7 and 300 K in fields up to 70 kOe on splat-cooled Ni-P-B amorphous alloys in the critical concentration range for the appearance of ferromagnetism. The onset of ferromagnetism is attributed to interactions between giant moments. For the composition range investigated, the magnetic contribution is arising mainly from moments of 5 to 6 microns sub B/ with a Kondo-type characteristic temperature of 1 K. ERA

DATA SUMMARY: Magnetic data on amorphous Ni-P-B alloys with compositions close to the critical concentration for the para-ferro transition; variables include magnetic field strength, temperature, magnetization, magnetic properties, magnetic susceptability; 3 figures and 1 table include numeric data.

N77-15137# Naval Research Lab., Washington, D.C.
EFFECT OF POTENTIAL SCATTERING ON THE LOW-TEMPERATURE SPIN-FLUCTUATION RESISTIVITY Final Report
D. J. Gillespie 15 Apr. 1976 14 p refs
(NRL Proj. M01-10; RR0220145)
(AD-A027037; NRL-7992) Avail: NTIS HC A02/MF A01 CSCL 20/3

The application of many-body techniques to explain the electronic properties of the nearly ferromagnetic metals Rh, Pd, and Pt and their alloys has greatly increased our understanding of these materials. Many of their electronic properties (such as magnetic susceptibility, specific heat, and electrical resistivity) can be accounted for by a model which explicitly includes a strong intra-atomic Coulomb interaction between the d-band electrons of opposite spin. GRA

DATA SUMMARY: Two cases of potential scattering are documented: (1) infinite mean path, and (2) extremely larger amounts of potential scattering; variables include fractional change, spectral density function/density of states, ratio of spin fluctuation momentum to Fermi momentum; 2 figures include numeric data.

N77-15138# Technion - Israel Inst. of Tech., Haifa. Material Mechanics Lab.
CONSTITUTIVE EQUATIONS FOR CYCLIC LOADING OF RATE DEPENDENT MATERIALS Interim Report, 1974 - 1976
S. R. Bodner and Y. Partom Apr. 1976 34 p refs
(Grant AF-AFOSR-2607-74; AF Proj. 6813; AF Proj. 9782)
(AD-A027655; MML-51; AFOSR-76-0772TR; SR-1;
ISSN-0072-9310) Avail: NTIS HC A03/MF A01 CSCL 11/6

The constitutive equations that have been developed by the authors to represent elastic-viscoplastic, strain-hardening materials have been modified to apply to changes in the direction of stressing. This modification involves altering the strain-hardening parameters with a change in the sign of the stress and also adding a linear viscosity term to the plastic deformation rate. These modifications are shown to have a physical basis and enable the constitutive equations to predict the general features of cyclic stress-strain behavior at various extension rates and strain amplitudes including the tendency toward a limit cycle. An unusual feature of cyclic loading tests on some metals is a local concavity of the stress-strain curve which is predicable by these equations. Cyclic stress-strain curves were calculated for titanium for various conditions and compared to corresponding experimental results. GRA

DATA SUMMARY: Results of cyclic loading tests and simulations; variables include stress, strain, time; 8 figures include numeric data.

N77-15139# Aeronautical Research Associates of Princeton, Inc., N.J.
ON FATIGUE CRACK GROWTH AND A STUDY OF SOME OF THE STRESS HISTORY PARAMETERS AFFECTING FATIGUE LIFE Final Report, 1 Jan. - 31 Dec. 1975
John C. Houbolt Mar. 1976 27 p
(Contract F44620-75-C-0035; AF Proj. 9782)
(AD-A027719; ARAP-273; AFOSR-76-0879TR) Avail: NTIS HC A03/MF A01 CSCL 11/6

The purpose of the study was to gain further insight of how structural fatigue life is influenced by various statistical properties of the applied load history. The main aim in the present study was to maintain careful control over the input parameters, such as the ratio of the maximum fluctuating stress to the rms value, or the zero crossing values associated with the load history and its time derivative. Control was also made over the initiation of crack growth. Loading of Aluminum alloy 2024 was composed of a constant mean load and a super-imposed fluctuating component. The fluctuating component was achieved through a combination use of several sine-wave generators. Prior to giving the results of the tests, some consideration is given to crack growth behavior and its analytic form. From this consideration, the basis for a generalized crack growth analysis is outlined. GRA

DATA SUMMARY: Controlled specimen fatigue tests under constant load with superimposed fluctuating loads; variables include mean load, fluctuating loads, crack length, life-till-failure, cycles to failures, and frequencies at which oscillating stresses were applied; 6 figures and 1 table include numeric data.

N77-15140# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
SURFACE CHARACTERIZATION OF TITANIUM AND TITANIUM ALLOYS. PART 2: EFFECT ON Ti-6Al-4V ALLOY OF LABORATORY CHEMICAL TREATMENTS Final Report, Jul. 1975 - Feb. 1976
William L. Baun and Neil T. McDevitt May 1976 57 p refs (AF Proj. 7340)
(AD-A027134; AFML-TR-76-29-Pt-2) Avail: NTIS HC A04/MF A01 CSCL 11/6

This investigation is part two of a program which looks at the effects of surface treatments on surface chemistry and morphology of titanium and titanium alloys. This part considers the effect of six surface treatments on the alloy titanium-6 aluminum-4 vanadium. Author (GRA)

DATA SUMMARY: Secondary ion mass spectrum, ion scattering spectrum, and auger electron spectrum of surface treated Ti and Ti-6Al-4V; variables include time, energy chemical surface treatments, elemental profiles, and surface composition; 22 figures and 3 tables include numeric data.

N77-15141# California Univ., Berkeley. Dept. of Mechanical Engineering.
THEORIES ON FLOW AND FRACTURE IN METALWORKING PROCESSES. PART 1: A THEORY OF METAL FLOW IN AXISYMMETRIC PIERCING AND EXTRUSION. PART 2: A THEORY ON DUCTILE FRACTURE IN METALWORKING PROCESSES Final Report, Mar. 1975 - Mar. 1976
S. N. Shah, Shiro Kobayashi, and S. I. Oh May 1976 134 p refs
(Contract F33615-75-C-5151; AF Proj. 7351)
(AD-A027266; AFML-TR-76-61-Pt-1) Avail: NTIS HC A07/MF A01 CSCL 11/6

The objective of this investigation was to establish theories on flow and fracture in order to apply workability theory to metalworking processes. It has been shown in the application to upsetting that the matrix method is a powerful tool for the analysis of metalworking deformation mechanics. In Part I the matrix method was refined by the use of a different linearization technique, and the area of its application was expanded through the introduction of a technique for effectively treating the nondeforming regions in the computation. The refined version of the method was then applied to a non-steady-state process of axisymmetric piercing and a steady-state process of axisymmetric extrusion. In part II the deformation mode of void growth was re-examined, using the model proposed previously but with formulations for large elastic-plastic deformation. The results show that the nonuniform mode due to void interaction could reduce the fracture strain by several times, compared to the results based on uniform void growth. The results also lead to a question as to the effect of the void-free surface interaction on the stress and strain fields and possible nonsymmetric bifurcation mode. GRA

DATA SUMMARY: Results of numerical analyses of various parameters of significance in metal working procedures; variables include pressure distribution, stress, strain, stress distribution, strain distribution, strain rate, height reduction; 22 figures and 1 table include numeric data.

N77-15142# Battelle Columbus Labs., Ohio.
COATED ANTENNA WIRE Final Report, 18 Nov. 1975 - 18 Mar. 1976
Donald M. Bigg, Michael M. Epstein, and Robert E. Maringer 18 Mar. 1976 43 p refs
(Contract F19628-76-C-0002; AF Proj. 627A)
(AD-A026918; ESD-TR-76-75) Avail: NTIS HC A03/MF A01 CSCL 09/5

The object of this project was to develop a method for coating high modulus steel and tungsten wires with a material containing a stable high atomic number particulate filler. Since the matrix material in this composite coating is sacrificed during use, a low cost, easily processed wire coating grade of polyethylene was chosen for the matrix. Tungsten, tungsten carbide, and lead were investigated as potential filler materials. These materials make suitable coating composites at up to 10 volume percent loading if the particulate fillers are free of contaminants. Coating problems encountered early in the program were identified as being caused by contaminated tungsten and tungsten carbide powders. Several interesting damping phenomena were identified during low-frequency torsional pendulum measurements of the coated wires, including a damping peak at approximately -30 C. Because a relationship between the quantity of filler surrounding the wire and the peak amplitude exists, it is suspected that the damping peak is caused by the tungsten carbide powder. Author (GRA)

DATA SUMMARY: Rheological study of a polyethylene matrix filled with tungsten, tungsten carbide, and lead particles; variables include filler size, filler loading, coating thickness, wire core, viscosity, shear rate, temperature, die swell, drawability, damping peak amplitude, frequency of oscillation; 12 figures and 3 tables include numeric data.

N77-15143# Illinois Univ., Urbana-Champaign. Dept. of Metallurgy and Mining Engineering.
SECOND PHASE EMBRITTLEMENT OF SOLIDS
H. K. Birnbaum Jun. 1976 7 p refs
(Contract N00014-75-C-1012)
(AD-A026204; UILU-ENG-76-5015) Avail: NTIS HC A02/MF A01 CSCL 11/6

Hydrogen embrittlement of niobium has been recently shown to be caused by the stress-induced formation and cleavage of the brittle beta hydride. It is the purpose of this note to review the general requirements for this fracture mechanism and to discuss its applicability to brittle fractures caused by the formation of other phases such as oxides, nitrides, carbides, helium bubbles, etc. It will be shown that this mechanism can play a role in the slow strain rate embrittlement of a variety of different systems. GRA

DATA SUMMARY: Embrittlement in different systems; variables include temperature, solute concentration; 1 table includes numeric data.

N77-15144# Florida Univ., Gainesville. Dept. of Materials Science and Engineering.
USE OF THE EXPERIMENTAL POURBAIX DIAGRAM FOR D6ac STEEL TO INTERPRET ITS CORROSION BEHAVIOR IN AQUEOUS MEDIA Final Report, 15 Nov. 1972 - 28 Jul. 1975
Ellis D. Verink, Jr. Wright-Patterson AFB, Ohio AFML Feb. 1976 107 p refs
(Contract F33615-73-C-5007; AF Proj. 7312)
(AD-A026830; AFML-TR-76-8) Avail: NTIS HC A06/MF A01 CSCL 11/6

An experimental potential vs. pH diagram for D6AC high strength steel in 0.1 molar NaCl aqueous solutions was established based on cyclic potentiodynamic polarization, potentiostatic titration, and atomic adsorption analyses. This diagram is useful in assessing the tendency for general corrosion, crevice corrosion, pitting corrosion, and stress corrosion cracking. An artificial occluded cell was devised for crevice studies, and the concept of crevice protection potential was verified for D6aC alloy in the aqueous solutions. GRA

DATA SUMMARY: Potential pH diagrams for D6aC steel in varied solutions, such as NaCl and $NaHCO_3$; variables include current density, composition, buffer molarity, pH, and time; 27 figures and 16 tables include numeric data.

N77-15145# California Univ., Los Angeles.
ACOUSTIC EMISSION CHARACTERISTICS OF STRUCTURAL STEELS
Kanji Ono, G. Huang, and H. Hatano Jun. 1976 10 p refs Presented at 8th World Conf. on Nondestructive Testing
(Contract N00014-75-C-0419)
(AD-A026603) Avail: NTIS HC A02/MF A01 CSCL 11/6

The paper describes acoustic emission behavior of C-Mn steels, 4130 steel SA533B steels during tensile and fracture toughness tests. Non-metallic inclusions were found to be the primary source of burst-type emission. GRA

DATA SUMMARY: Measured waveforms of acoustic emission from structural steels; variables include stress, frequency, power

density functions, strain, time, load, acoustic emission; 10 figures include numeric data.

N77-15146# Army Materials and Mechanics Research Center, Watertown, Mass.
AUSTENITE STABILITY AND TENSILE PROPERTIES OF WARM-EXTRUDED TRIP STEELS Final Report
Morris Azrin, Gregory B. Olson, and Roger A. Gagne May 1976 15 p refs
(DA Proj. 1T1-62105-AH-84)
(AD-A026099; AMMRC-TR-76-16) Avail: NTIS HC A02/MF A01 CSCL 11/6

High austenite stability resulting from a variation of working temperatures during warm extrusion caused insufficient work hardening and a loss of ductility in warm-extruded TRIP steel. The austenite stability could be adjusted, however, by a tempering treatment to remove some carbon from solid solution, giving tensile properties equivalent or superior to those obtained by warm rolling. Difficulties in alloy composition control or temperature control during processing of TRIP steels can thus be compensated by a simple final heat treatment. Author (GRA)

DATA SUMMARY: Characteristics of extruded steel; variables include weight %, temperatures, tensile strength, elongation, Young's modulus, reduction of area, stress, strain; 3 figures and 3 tables include numeric data.

N77-15147# Bureau of Mines, College Park, Md. Metallurgy Research Center.
XRF4-COMPUTER PROGRAMMING FOR X-RAY ANALYSIS
Harold E. Marr, III Jul. 1976 38 p refs
(PB-257387/1; BM-IC-8712) Avail: NTIS HC A03/MF A01 CSCL 11F

The computer program XRF4 was designed to provide for the calculation of several different interelement correction procedures in X-ray fluorescence analysis, including Lachance-Traill, Rasberry-Heinrich, and Claisse-Quintin procedures. The program was written in the BASIC language for timesharing application, and a conversational interaction with the computer is employed during operation. Test problems using data for iron-nickel-chromium alloys and aluminum alloys, and directions for use of the program are presented. GRA

DATA SUMMARY: Intensity-concentration relationship of iron in Aluminum alloys; variables include % concentration, intensity, interelement method, goodness of fit; 2 tables include numeric data.

N77-15148# Watervliet Arsenal, N.Y.
ANODIC POLARIZATION BEHAVIOR OF IRON-ALUMINUM ALLOYS IN SULPHURIC ACID
F. Saegusa Jun. 1976 42 p refs
(DA Proj. 1T1-61101-A-91A)
(AD-A026708; WVT-TR-76023) Avail: NTIS HC A03/MF A01 CSCL 11/6

The anodic polarization of iron-aluminum alloys has been investigated by the potentiostatic technique in hydrogen saturated sulfuric acid solutions. All alloys containing up to 20 w/o aluminum exhibited active, passive and transpassive characteristics. An improvement in corrosion resistance was seen for alloys with aluminum content of more than 16 w/o which may be attributed to the ordered phase Fe3Al. Micrographs of the surface of anodically polarized alloy were examined at selected potentials, and the surface topography showed a significant difference in accordance with the reaction mechanism in each step of anodic polarization. Author (GRA)

DATA SUMMARY: Corrosion potential of iron and iron compounds is presented; variables include current density, potential vs voltage, atomic percentage aluminum, temperature, and corrosion potential; 6 figures and 5 tables include numeric data.

N77-15149# Polytechnic Inst. of New York, Brooklyn.
PLASTIC FLOW AND FATIGUE BEHAVIOR OF ALPHA-BETA TITANIUM ALLOYS Annual Report, 1 Apr. 1975 - 31 Mar. 1976
Harold Margolin and Yashwant Mahajan 1 Jun. 1976 84 p refs
(Contract N00014-75-C-0793; NR Proj. 031-779)
(AD-A026609; AR-1) Avail: NTIS HC A05/MF A01 CSCL 11/6

Void formation, void growth and tensile fracture was studied in ELI Ti-6Al-4V heat treated to strengths of 110 ksi (758 MN/sq m) to 140 ksi (965 MN/sq m) for both equiaxed and Widmanstatten plus grain boundary alpha structures. Void formation occurred at alpha-matrix interface, at alpha-alpha boundaries and at twin-untwin interfaces within alpha particles. Void growth was found to be a function of microstructure, being more rapid at grain boundary alpha-matrix locations than in equiaxed alpha structures. A plot of corrected fracture stress, shows separate curves with about the same slope, for equiaxed and grain boundary alpha structures, with the equiaxed alpha structures showing the higher fracture stresses. The dependency of void growth at grain boundaries on grain size and strain hardening rate is discussed. Initial work on low cycle fatigue behavior at constant strain of the Ti-6Al-2Sn-4Zr-6Mo alloy is outlined, and plans for the study of factors controlling the yield strength of alpha-beta Ti alloys are presented. GRA

DATA SUMMARY: Eli Ti-6Al-4V was heat treated to produce either a Widmanstatten plus grain boundary alpha structure or an equiaxed alpha structure; variables include heat treatment, yield strength, elongation, % beta, true stress-true strain relations; void growth rate, strain hardening rate, beta grain size, and Larson-Miller parameter; 18 figures and 6 tables include numeric data.

N77-15150# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
THERMODYNAMICS OF THE HIGH-TEMPERATURE PHASES OF ALLOY STEELS Final Report, 1 Jun. 1973 - 31 Mar. 1976
John F. Elliott and John Chipman 24 Jun. 1976 19 p refs
(Contract DAHC04-73-C-0027)
(AD-A026772; ARO-11415.6-MC) Avail: NTIS HC A02/MF A01 CSCL 11/6

This summary report includes brief abstracts of the papers generated under this project since 1967. The abstracts are grouped by subject matter in preference to the more usual individual abstracts. The data are applicable to problems of the solidification and thermal treatment of alloy steels and to the design of new alloys. The system studied, the nature of the studies and the references to the published papers are also shown in a summary table. GRA

DATA SUMMARY: No numeric data are presented.

N77-15151# Michigan Technological Univ., Houghton. Dept. of Metallurgical Engineering.
STRUCTURE-PROPERTY RELATIONS IN A METASTABLE BETA Ti ALLOY CONTAINING Si
D. E. Graham and D. A. Koss Jun. 1976 29 p refs
(Contract N00014-76-C-0037)
(AD-A027031; TR-5) Avail: NTIS HC A03/MF A01 CSCL 11/6

The hardness response, tensile behavior, and phase transformations occurring in a quenched and aged metastable Beta-phase Ti-30 a/o V - 1 a/o Si alloy was investigated. Upon aging at 570C, as-quenched samples show a broad hardness peak which is associated with the formation of rod-like, hexagonal (Ti, V)xSiy transition phase precipitates. Faceted, tetragonal (Ti,V)3Si particles are also observed upon aging at 570C and are concluded to be the equilibrium silicide. The presence of the (Ti,V)3Si phase on the grain boundaries results in a loss of tensile ductility and a transition to intergranular fracture after extended aging at 570C. Comparing the behavior of Ti-30V to that of Ti-30V-1Si shows that the presence of Si strongly retards non-Burgers alpha-phase formation. However, a substantial age hardening response still occurs upon aging at 450C, especially after prior cold work (the yield strength increases from 635 MPa to 982 MPa). This hardening increment is combined with a retention of a ductile, transgranular fracture even after extended aging at 450C. GRA

DATA SUMMARY: Influence of prior aging at 570 C on the incremental increase in hardness upon subsequent aging at 450 C; variables include hardness and aging time; 2 figures include numeric data.

N77-15152# Advisory Group for Aerospace Research and Development, Paris (France).
ADVANCED FABRICATION TECHNIQUES IN POWDER METALLURGY AND THEIR ECONOMIC IMPLICATIONS
Nov. 1976 240 p refs In ENGLISH partly in FRENCH Presented at the 42d Meeting of the AGARD Struct. and Mater. Panel, Ottawa, Can., 4-9 Apr. 1976
(AGARD-CP-200; ISBN-92-835-0171-3) Avail: NTIS HC A11/MF A01

The technological and economic achievements of powder metallurgy techniques are considered. The production of powders, the state-of-the-art of techniques for consolidation of titanium and superalloy powders to near net shapes, development of improved materials qualities, and cost reduction are emphasized. For individual titles, see N77-15153 through N77-15178.

DATA SUMMARY: Diverse data are presented; variables include composition, position, tensile properties; density, flow rate, time, diameter, pressure, surface area, and distance.

N77-15153# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
TRENDS IN THE APPLICATION OF ADVANCED POWDER METALLURGY IN THE AEROSPACE INDUSTRY
G. P. Peterson *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 9 p (For primary document see N77-15152 06-26)
Avail: NTIS HC A11/MF A01

A variety of jet propulsion and airframe components were examined in terms of cost factors. It is shown that the dominant factor in increasing costs is metal removal or machining. Powder metallurgy is proposed as a means of reducing the costs of machining engine and aircraft components. Hot isostatic pressing, rotating electrode process, press and sinter, and extrusion are among the processes discussed. J.M.S.

DATA SUMMARY: Cost comparison of raw materials and various machining processes for superalloy turbine disks; variables include % price increase, potential cost savings, cost ($/lb), quality, industry capacity (lb/yr), mechanical properties; 1 figure and 5 tables include numeric data.

N77-15154# Commissariat a l'Energie Atomique, Grenoble (France).
PRODUCTION OF POWDERS FROM TITANIUM ALLOYS BY VACUUM FUSION CENTRIFUGATION [PRODUCTION DE POUDRES D'ALLIAGES DE TITANE PAR FUSION-CENTRIFUGATION SOUS-VIDE]
Jacques Decours, Jacques Devillard, and Gerard Sainfort *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 13 p In FRENCH (For primary document see N77-15152 06-26)
Avail: NTIS HC A11/MF A01

A process is presented for fabricating powders of TA6V and TA625D alloys elaborated by fusion centrifugation under electron bombardment. An apparatus is described with a capacity for industrial production of metal powder. The properties of the powder thus fashioned are discussed. Large pieces of metal have been worked by frit and spinning at temperatures between 850 and 1100 C. The structural and mechanical properties of the products in the cold state are compared before and after heat treatment.
Transl. by A.H.

DATA SUMMARY: Mechanical and structural properties of titanium alloys before and after heat treatment at 850 C to 1100 C; variables include composition of the alloys, composition of the powders, dimensions of the spherules, phase transformation, pressure of frit bars, reduction ration, resistance coefficient; 9 figures and 4 tables include numerical data.

N77-15155# Nuclear Metals, Inc., West Concord, Mass.
PRODUCTION OF TITANIUM POWDER BY THE ROTATING ELECTRODE PROCESS
Gerald Friedman *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 5 p (For primary document see N77-15152 06-26)
Avail: NTIS HC A11/MF A01

The titanium alloy powder made by the rotating electrode process consists of closely-sized, high purity spherical particles within the range of 50-500 micrometers. Although earlier REP powders had been produced by a technique employing a tungsten cathode, this source of contamination was eliminated as a result of process modifications which make use of titanium cathodes, in either a consumable or nonconsumable mode.
Author

DATA SUMMARY: Characteristic attributes of rotating electrode process for Ti-6Al-4V powder; variables include composition, size range, size distribution, density, flow rate, surface area; 1 table includes numeric data.

N77-15156# Leybold-Heraeus G.m.b.H., Hanau/Main (West Germany).
PRODUCTION OF HIGH PURITY METAL POWDER BY ELECTRON BEAM TECHNIQUE
H. Stephan *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 6 p (For primary document see N77-15152 06-26)
Avail: NTIS HC A11/MF A01

Manufacturing of metal powders, especially of titanium and nickel-super-alloys of highest purity in the most economical way is discussed. The powder can be of 100% spherical shape and of 50 - 600 micron diameter and of flake size of 20 - 400 mesh or a mixture of both. High purity is achieved by processing in high vacuum, melting with the programmed electron beam and atomizing with a water-cooled rotating disk. This allows reduction of hydrogen from Ti-alloys and reduction of C, O2, H2 and N2 from Ni-super-alloys and avoids contamination of the metal powder from the environment, the heat source and the atomizing system.
Author

DATA SUMMARY: Chemical analysis of Ti- and Ni-alloys before and after electron beamwelding; variables include chemical composition, starting material, spherical powder, splashed powder; 1 table includes numeric data.

N77-15157# Atomic Energy Research Establishment, Harwell (England). Chemistry Div.
TITANIUM POWDER PRODUCTION BY THE HARWELL CENTRIFUGAL SHOT CASTING PROCESS
P. W. Sutcliffe and P. H. Morton (Imperial Metal Ind. (Kynoch), Ltd., Birmingham, Engl.) *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 4 p refs (For primary document see N77-15152 06-26)
Avail: NTIS HC A11/MF A01

The centrifugal shot casting (CSC) process, which has particular relevance to the production of titanium alloy powders is briefly described. The process is one of several centrifugal atomization techniques being developed throughout the world which incorporates the mechanism of disintegration of molten titanium into discrete droplets. The melting of a titanium alloy electrode and the subsequent atomization as it takes place in the CSC process is illustrated. In addition, calculations of the time taken for pure titanium droplets of 50-500 micrometers diameter to solidify in flight are presented, as well as the distances traversed during solidification. The dependence of these parameters upon the nature and pressure of the inert gas environment is considered. Author

DATA SUMMARY: Solidification of titanium droplets in helium and argon environment; variables include cooling time, sphere diameter, pressure, horizontal distance traveled; 2 figures and 1 table include numeric data.

N77-15158# Allmanna Svenska Elektriska A. B., Robertsfors (Sweden).
PERFORMANCE AND ECONOMICS OF HIP EQUIPMENT IN INDUSTRIAL USES
Hans T. Larker *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 6 p (For primary document see N77-15152 06-26)
Avail: NTIS HC A11/MF A01

Hot isostatic pressing (HIP) is an established process within some segments of industry and ample experience has been gained from the use of ASEA QUINTUS(R) HIP equipment in production, both cold loaded for cemented carbide products and hot loaded for high speed tool steel. A design for the insulation system of HIP furnaces invented about ten years ago and then further developed has proven to give high reliability and low maintenance cost. Examples of HIP processing costs for a cold loaded unit and a hot loaded pressing line are given. The calculated costs ranging from some tens of cents to about a dollar per kg material being treated should enable a rapidly increasing use of the HIP process. Author

DATA SUMMARY: Effect of hot isostatic pressing on porosity; variables are pore size, number of pores per 100 sq.cm. area, costs per production cycle; 3 figures include numeric data.

N77-15159# Autoclave Engineers, Inc., Erie, Pa.
PROCESS AND ECONOMIC CONSIDERATIONS FOR PRODUCTION SCALE HOT ISOSTATIC PRESSING EQUIPMENT
Charles W. Smith, Jr. *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 7 p (For primary document see N77-15152 06-26)
Avail: NTIS HC A11/MF A01

Equipment which makes the hot isostatic pressing process an economical and viable industrial process is now well developed. Hot and cold loading process systems are compared at a production rate of one cycle per eight hour day. Other comparisons of the two systems include equipment types, equipment costs, and the effect of material processed. Author

DATA SUMMARY: No numeric data are presented.

N77-15160# Conaway Pressure Systems, Inc., Columbus, Ohio.
NOTES ON SOME ECONOMIC ASPECTS OF HIP
R. M. Conaway *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 5 p (For primary document see N77-15152 06-26)
Avail: NTIS A11/MF A01

Two areas of interest involving hot isostatic processing are addressed. Some of the considerations involved in the concept of operation with respect to preheat are presented. Additionally, some of the results of a study intended to give indications of floor-to-floor processing costs are briefly presented. Author

DATA SUMMARY: Costs of partial preheating, preheating, and vessel resident heating are compared; variables include nondimensional temperature, nondimensional time, nondimensional power, reduction of minimum heating time, preheat amount (% of desired temperature), total cost per gross volume, total cost per unit mass; 4 figures include numeric data.

N77-15161# Wiggin (Henry) and Co. Ltd., Hereford (England).
NICKEL SUPERALLOY POWDER PRODUCTION AND FABRICATION TO TURBINE DISCS
C. H. Symonds and F. A. Thompson *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 14 p refs (For primary document see N77-15152 06-26)
Avail: NTIS HC A11/MF A01

One area of application has received more attention than any other, this being turbine disks where the requirement is not for the ultimate in high temperature resistance but for optimized mechanical properties at intermediate temperatures. These components lend themselves ideally to manufacture by the powder route since nearly all the advantages of powders over conventional routes can be utilized. An integrated powder production and compaction plant was installed aimed at the commercialization of this type of component. Work on the forging of disks from hot isostatically pressed (HIP) billet is reviewed along with indications of the potential for other techniques applicable to the production of powder disks, i.e. preforms plus forging, direct HIP to shape, isothermal forging, thermoplastic processing. Author

DATA SUMMARY: Two APK1 alloys are compared with three cast wrought disk alloys for ultimate tensile strength and 0.2% strength; variables include strength, bulk density, tap density, flow rate, ppm, position; 4 tables and 1 figure include numeric data.

N77-15162# Pratt and Whitney Aircraft, East Hartford, Conn.
MANUFACTURE OF LOW COST P/M ASTROLOGY TURBINE DISKS
Dennis J. Evans *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 6 p (For primary document see N77-15152 06-26)
Avail: NTIS HC A11/MF A01

The use of powder metallurgy to produce components from difficult-to-forge alloys was demonstrated. However, as the costs of raw materials, labor, and processing increase rapidly, the stimulus for continued powder processing development shifts from performance to that of raw material conservation and cost reduction. It was the object of this program to demonstrate the reproducibility of the product obtained from the forging of annular preforms using a carbon modified Astrology powder and to establish production processes and specifications relevant to this product. The technical approach taken was to procure hot isostatically pressed low carbon Astrology forging preforms from two powder sources. One source utilized high pressure consolidation, the other low pressure consolidation. These as-HIP'ed preforms were hammer forged. Subsequent mechanical property evaluation verified the quality of these components and a disk for engine qualification was made available for testing. Author

DATA SUMMARY: No numeric data are presented.

N77-15163# Avco Lycoming Div., Stratford, Conn. Materials and Process Technology Labs.
ADVANCEMENTS IN SUPERALLOY POWDER PRODUCTION AND CONSOLIDATION
Louis J. Fiedler *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 9 p (For primary document see N77-15152 06-26)
Avail: NTIS HC A11/MF A01

A program was initiated to reduce the cost of fabricating superalloy turbine engine components through the utilization and improvement of powder metallurgical techniques. To date, investigations were conducted on both powder production and powder consolidation. Specifically, it was demonstrated that the cost of powder production could be significantly reduced at the expense of small property changes through the use of virgin materials and powder revert during melting, minimizing inert handling, and the use of coarser mesh fractions. Relative to consolidation, it was also shown that ceramic molds can be used to produce near net shaped parts by direct HIP or by sinter plus HIP techniques. The verification of these processes is currently in progress through the fabrication and evaluation of a full scale turbine disk with an integral stub shaft. Author

DATA SUMMARY: Program characteristics and compacted billet properties of direct HIP and sinter + HIP; variables include tensile properties, stress rupture, melting, powder particle size, powder handling, temperature, time; 4 tables include numeric data.

N77-15164# Pratt and Whitney Aircraft, West Palm Beach, Fla. Government Products Div.
ISO-FORGING OF POWDER METALLURGY SUPERALLOYS FOR ADVANCED TURBINE ENGINE APPLICATIONS
M. M. Allen *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 15 p (For primary document see N77-15152 06-26)
Avail: NTIS HC A11/MF A01

The Gatorizing forging process is a hot die isothermal technique used to produce complex configurations. This process utilizes the superplastic behavior imparted to advanced superalloys through prior processing and/or controlled forging parameters.

This technique is currently being used in the production of all of the turbine disks and many of the compressor disks used in the F100 engine program. The Gatorizing technique has allowed production of a diverse array of precision forged net and near net shape superalloy components. Because the process uses hot dies and relatively low forming rates, the response of the as-Gatorized workpiece to subsequent heat treatment is remarkably uniform. Finally the Gatorizing process offers strong economic advantages over conventional forming techniques in applications which use expensive raw materials, require maximum material properties, or require complex component configuration. Author

DATA SUMMARY: No numeric data are presented.

N77-15165# Homogeneous Metals, Inc., Herkimer, N. Y.
METAL POWDER PRODUCTION BY VACUUM ATOMIZATION
J. M. Wentzell *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 6 p (For primary document see N77-15152 06-26)
Avail: NTIS HC A11/MF A01

The potential energy for atomization can be stored within the molten metal, which increases the efficiency. Also, the higher tap densities of vacuum-atomized powders, as compared with argon-atomized powders, is a distinct advantage. Alloy powders based on Ni, Co, Fe, Cu, Al, and misch metal were made successfully by this process. Powder metallurgy will play a significant role in this era of conservation and cost reduction, and vacuum atomization has shown that the unconventional approach may offer the most practical solutions to some of our current problems. Author

DATA SUMMARY: No numeric data are presented.

N77-15166# General Electric Co., Cincinnati, Ohio.
RENE 95 POWDER METALLURGY OPPORTUNITIES FOR GAS TURBINE APPLICATIONS
David B. Arnold *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 6 p (For primary document see N77-15152 06-26)
Avail: NTIS HC A11/MF A01

An intensive effort in powder metallurgy was initiated for Rene 95 when the powder metallurgy approach emerged as a viable technology through the combined development of powder production and hot isostatic pressing. The status of this effort is reviewed, and the major directions are indicated in which powder metallurgy Rene 95 is likely to make the most significant contributions. Author

DATA SUMMARY: Tensile, creep/rupture, and sustained peak LCF properties of PM Rene 95 were compared to cast-wrought forging; variables included tensile strength, temperature, stress, cycles to failure, cost reduction potential; 3 figures and 1 table include numeric data.

N77-15167# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
INVESTIGATIONS FOR MANUFACTURING TURBINE DISCS OF NI-BASE SUPERALLOYS BY POWDER METALLURGY METHODS
W. Betz, H. Huff, W. Track, M. Brandis, F. Schubert, and W. Spyra *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 19 p (For primary document see N77-15152 06-26)
Avail: NTIS HC A11/MF A01

The potential advantages arising from powder metallurgical production of turbine disks using different processing methods are discussed. Research work included the following production methods: (1) powder compressed by hot extrusion, disk shaping by forging in a conventional forging press; (2) Argon-atomized powder compressed by hot isostatic pressing (HIP), disk shaping by forging in a conventional forging press; and (3) Argon-atomized powder, compression and simultaneous disk shaping by HIP. The influence of different steps is discussed, e.g. HIP-parameters, forging parameters and heat treatments on microstructure and results of tensile tests (from RT up to 800 C), creep rupture test (650 C and 730 C), and low cycle fatigue tests (test bars at RT and 600 C and spinned disks at RT). Parameters were found for HIP in combination with thermomechanical post treatment which produce a microstructure in which the previous particle grain boundaries are not densely covered by carbides. This microstructure leads to mechanical and technological properties which appear to to be adequate for the use of these PH-materials for turbine disks. Author

DATA SUMMARY: Stress rupture properties of PM U 700 are presented; variables include temperature, stress, heat treatment, time of rupture, elongation, pressure, time, revolutions per minute, cycles to crack initiation; 9 figures and 5 tables include numeric data.

N77-15168# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Corbeil (France).
INFLUENCE ON THE MECHANICAL PROPERTIES OF VARIOUS PROCESSING PARAMETERS APPLIED TO NICKEL BASE SUPERALLOYS POWDERS
Pierre Lescop, Michel Marty, and Andre Walder *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 12 p In FRENCH; ENGLISH summary (For primary document see N77-15152 06-26)
Avail: NTIS HC A11/MF A01

The characteristics of nickel-base alloys, fabricated from prealloyed powders, are influenced by each of the successive operations. The effect of the main parameters are shown, such as: (1) powder atomization process (rotative electrode, argon atomization), (2) powder granulometry, (3) carbon content of the alloy, (4) densification mode (extrusion, conventional isostatic compacting, fast isostatic compacting, pseudo-isostatic uniaxial compression), and (5) thermal treatments and forging conditions according to the temperature range considered for the application. The structures and the mechanical properties (tension, creep, low cycle fatigue) are examined on alloys fabricated at laboratory scale (IN 100, Astroloy) and on industrial products of various origins (Rene 95, Astroloy low carbon). Author

DATA SUMMARY: Effect of parameters on nickel-base superalloy characteristics; variables include elastic limit, thermodynamic properties, rupture strength, compaction, fatigue resistance, mechanical properties, heat treatment, carbon density; 11 figures include numeric data.

N77-15169# National Aeronautical Establishment, Ottawa (Ontario).
CONTROL OF GRAIN STRUCTURE DURING SUPERALLOY POWDER PROCESSING
W. Wallace, J-P. A. Immarigeon, J. M. Trenouth, and B. D. Powell *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 13 P refs (For primary document see N77-15152 06-26)
Avail: NTIS HC A11/MF A01

Factors which influence the control of grain structure during hot isostatic pressing of nickel-base superalloy powders are examined. The gamma precipitate can be used to control grain structure below the gamma solvus, while carbide precipitation on grain and particle boundaries controls the structure at higher temperatures. Carbon and sulphur are the main interstitials on particle boundaries. Flow properties, fracture behavior, and recrystallization during hot forging depend on temperature, strain, strain rate, and initial grain structure of the compact. The effects of these forging variables on final microstructure are examined. Author

DATA SUMMARY: Mechanical properties from 10 materials (as-pressed, pressed, and heat treated superalloy compacts); variables include true strain, true stress, energy, weight percent minor phase content, tensile properties, stress rupture properties; 4 figures and 2 tables include numeric data.

N77-15170# Canadian Westinghouse Co., Ltd., Hamilton (Ontario). Turbine and Generator Div.
POWDER FABRICATION OF FIBRE-REINFORCED SUPERALLOY TURBINE BLADES
P. J. Mazzei, G. Vandrunen, and M. J. Hakim *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 16 p refs (For primary document see N77-15152 06-26)

Avail: NTIS HC A11/MF A01

A powder metallurgy process was developed to produce superalloy matrix-thoriated tungsten composite shapes. The continuous deposition of hafnium carbide and hafnium nitride diffusion barriers on tungsten wire by chemical vapor deposition was demonstrated. Coated fibers were combined with matrix alloy tape to produce composite plies. The plies can be stacked, outgassed and consolidated by hot isostatic pressing into near-net or possibly net composite shapes. Author

DATA SUMMARY: Characteristics of a matrix alloy powder, regenerative gas turbine engine, and superalloy airfoil materials; variables include particle size distribution, shaft power, thermal efficiency, specific stress, rupture life, time, argon pressure, temperature; 4 figures and 2 tables include numeric data.

N77-15171# Centre de Recherches Metallurgiques, Liege (Belgium).

HIGH-STRENGTH POWDER-METALLURGY COBALT-BASE ALLOYS FOR USE UP TO 650 DEG C

J. M. Drapier, P. Viatour, D. Coutsouradis, and L. Habraken *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 14 p refs (For primary document see N77-15152 06-26)

Avail: NTIS HC A11/MF A01

The possibility of obtaining high strength levels at intermediate temperatures in experimental cobalt-base alloys prepared by powder metallurgy (P/M) techniques was investigated. The first part of the work concerned P/M grades containing (in wt.%) 10 to 15%Ni, 20%Cr, 10%Mo and up to 1.8%C, strengthened mainly by solid solution effects and precipitation of carbides. The second part dealt with P/M grades containing (in wt.%) 16%Cr, 3 to 5%Mo, 5%Ti and less than 0.1%C strengthened by solid solution effects and precipitation of the ordered f.c.c. gamma-Co3Ti intermetallic compound. Prealloyed powders sizing less than 500 microns were prepared by N2 atomization and, for some of the Ti-containing grades, by the rotating electrode process. After consolidation by hot extrusion of canned powders, the alloys were hot worked by rolling or swaging and subjected to a final aging treatment. Ultimate tensile strengths up to 1850 MN/sq. m at room temperature and 1350 MN/sq. m at 650 C (1200 F) were obtained in the gamma-Co3Ti strengthened alloys. Relationships between microstructures and mechanical properties are discussed in terms of the powder characteristics, and the extrusion and subsequent hot working and aging conditions. Author

DATA SUMMARY: Characteristics of cobalt alloys produced by powder metallurgy; variables include weight %, tensile strength, elongation, size, temperature, stress rupture life, carbon content, hardness, time; 6 figures and 1 table include numeric data.

N77-15172# Imperial Metal Industries (Kynoch) Ltd., Birmingham (England).

COMPARATIVE EVALUATION OF FORGED Ti-6Al-4V BAR MADE FROM SHOT PRODUCED BY THE REP AND CSC PROCESSES

R. F. Vaughan, P. A. Blenkinsop, and P. H. Morton *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 7 p refs (For primary document see N77-15152 06-26)

Avail: NTIS HC A11/MF A01

Ti-6Al-4V shot was obtained from two sources, the centrifugal shot casting process and the rotating electrode process. The chemistry and size distribution of the two types of shot were compared prior to an evaluation of the consolidated products. Alloy shot billets were produced by hot isostatic pressing (HIP) and the mechanical properties of as-HIP and as-HIP + forged/rolled material were compared. The two types of shot behaved in a similar manner and generally produced microstructures, tensile and fracture toughness properties similar to cast and wrought material. However, the low cycle fatigue behavior of the consolidated material was inferior to that observed in the conventional product. Internal fatigue origins were found to be associated with defects in the shot and in general the degree of scatter was higher and fatigue strengths were lower than in conventional material of a similar section size. Author

DATA SUMMARY: Characteristics of alloy shot and bars produced from shot and conventional methods; variables include weight %, size, stress, cycles, tensile strength, elongation; 2 figures and 4 tables include numeric data.

N77-15173# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Central Lab.

SOME COMMENTS ON THE MECHANICAL PROPERTIES OF HIP TITANIUM

Wolfgang Keinath *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 12 p (For primary document see N77-15152 06-26)

Avail: NTIS HC A11/MF A01

The mechanical properties of HIP titanium TiAl6V4 produced under different conditions are discussed and the factors which influence the fatigue values are investigated. Author

DATA SUMMARY: Characteristics of TiAl6V4 powder and hot pressed specimens; variables include ppm, grain size, weight %, tensile strength, yield strength, elongation, temperature, stess cycle, stress amplitude, KeV; 5 figures and 1 table include numeric data.

N77-15174# General Electric Co., Evendale, Ohio.

HOT ISOSTATIC PRESSING OF Ti-6Al-4V POWDER FORGING PREFORMS

R. E. Peebles *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 6 p refs (For primary document see N77-15152 06-26)

Avail: NTIS HC A11/MF A01

Data are presented concerning powder characterization, hot isostatic pressing (HIP) parametric studies, producing and forging HIP preforms, and the determination of many mechanical properties from forgings as well as as-HIP material. The results of the mechanical property testing are compared to those of the conventional cast and wrought approach as well as to each other. The economics of forging powder preforms, and of using the alloy in the as-consolidated (by HIP) are discussed as well as current problems. Author

DATA SUMMARY: Chemical composition of billet and powder; variables include weight %; 1 table is presented.

N77-15175# Air Force Materials Lab., Wright-Patterson AFB, Ohio.

WELDABILITY OF HOT ISOSTATICALLY PRESSED PREALLOYED TITANIUM 6Al-4V POWDERS

R. F. Geisendorfer, L. P. Clark, and M. A. Greenfield *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 5 p refs (For primary document see N77-15152 06-26)

Avail: NTIS HC A11/MF A01

The prealloyed Ti 6Al-4V powder shapes investigated included REP spherical powder and H/DH irregular powder. Both types were evaluated after three different time-temperature-pressure HIP combinations. In addition, a fourth HIP cycle above the beta transus was conducted with spherical powder only. Welding was conducted on as-compacted material using the bead-on-plate gas tungsten arc technique with full penetration and constant weld parameters. Weldments were evaluated by bend, tensile, and toughness testing in conjunction with radiographic and metallographic techniques. Author

DATA SUMMARY: Characteristics of welded HIP alloy; variables include temperature, density, yield strength, ultimate strength, reduction of area, elongation, fracture toughness; 2 tables include numeric data.

N77-15176# Grumman Aerospace Corp., Bethpage, N.Y. Advanced Materials and Processes Development.

NEAR-NET POWDER METALLURGY AIRFRAME STRUCTURES

R. H. Witt *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 8 p refs (For primary document see N77-15152 06-26)

Avail: NTIS HC A11/MF A01

The use of powder metallurgy for the reduction or minimization of the acquisition cost of titanium alloy airframe parts is discussed.

The results of studies regarding the following processes are presented: (1) cold isostatic pressing and sintering to produce high density preforms for subsequent hot forging to full-density, near-net shapes, (2) hot pressing of shapes, and (3) hot isostatic pressing to full-density, near-net shapes in a one-step operation. The primary titanium alloys investigated were Ti-6Al-4V and Ti-6Al-6V-2Sn. Advantages, disadvantages, technological and economic considerations are summarized for each approach and potential future airframe applications are presented. Author

DATA SUMMARY: Characteristics of titanium alloy specimens produced by powder metallurgy; variables include density, tensile strength, yield strength, elongation, fracture toughness, fatigue limit, Charpy v-notch impact strength, stress, HIP temperature, oxygen content; 2 figures and 6 tables include numeric data.

N77-15177# Atomic Energy Research Establishment, Harwell (England). Chemistry Div.
POWDER PRODUCTION, PART 1 Final Summary
P. W. Sutchiffe *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 4 p (For primary document see N77-15152 06-26)
Avail: NTIS HC A11/MF A01

Methods for producing titanium alloy and nickel alloy powders are briefly reviewed. D.M.L.

DATA SUMMARY: Characteristics of powders and production processes; variables include atmospheric pressure, melting rate, size, density; 1 table includes numeric data.

N77-15178# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
POWDER CONSOLIDATION, PART 2 Final Summary
Larry P. Clark *In* AGARD Advan. Fabric. Tech. in Powder Met. and Their Econ. Implications Nov. 1976 5 p (For primary document see N77-15152 06-26)
Avail: NTIS HC A11/MF A01

The state-of-the-art for powder consolidation and associated processing techniques is discussed. The sequence from the handling of powder, through consolidation and to evaluation of the final products is followed. Conclusions are drawn as to the state-of-the-art of powder consolidation into usable shapes and recommendations are made for future activities. Author

DATA SUMMARY: No numeric data are presented.

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N77-15179 British Library Lending Div., Boston Spa (England).
INFLUENCE OF GAS ABSORPTION ON DELAYED FRACTURE INDUCED BY WATER VAPOUR IN QUENCHED GLASS
J. F. Antonini and P. Acloque 7 Oct. 1974 17 p refs Transl. into ENGLISH from Glastech. Ber. (West Ger.), v. 47, no. 4, 1974 p 57-62
(BLL-DRIC-Trans-3704-(3623.66)) Avail: British Library Lending Div., Boston Spa, Engl.: 2 UK BLL photocopy coupons

Vacuum technique together with mass spectrometry makes possible an interesting extension of the experiments of ACLOQUE and MORAIN on the development of fractures in tempered glass by static fatigue. A more detailed and quantitative investigation of the interaction of different gases with the primary fracture surface and the effects of preliminary adsorption of these gases on subsequent fracture under water vapor was made. The results of ACLOQUE and MORAIN were confirmed. In addition, it was shown that the existence of an adsorbed gas layer on the primary fracture surface can influence the secondary fracture induced by water vapor (static fatigue). Author

DATA SUMMARY: Measurements of secondary fracture formation in different gas atmospheres; variables include time, water vapor, atmospheric composition; 1 figure and 1 table include numeric data.

N77-15180 Polish Academy of Sciences, Warsaw.
CONTRACTION OF NETWORK CHAINS IN POLYMER NETWORKS
J. Walasek 16 Feb. 1976 23 p refs in POLISH; ENGLISH summary
Avail: Issuing Activity

The contraction coefficient of the elastic part of a crosslinked system, defined as the ratio of the average square end-to-end distance of a network chain to the similar square end-to-end distance for an isolated network chain was calculated. For ideal networks with a constant functionality and for ideal tetrafunctional systems, the contraction coefficient reduces to the form A sub ef = 1/2. Author

DATA SUMMARY: No numeric data are presented.

N77-15181 Missouri Univ., Rolla.
NUCLEATE BOILING FROM POLYMER COATED SURFACES Ph.D. Thesis
David Franklin Warner 1973 136 p
Avail: Univ. Microfilms Order No. 76-26873

The nucleate boiling curve (the curve resulting from plotting heat transferred per unit area versus the temperature difference between the coiling surface and the liquid pool) of the polymer coated surfaces were compared with the nucleate boiling curve of gold plated surfaces with no polymer coat. It was found that the thicker the polymer coat, the more the curve deviated from that of the metal uncoated surfaces. All surfaces were examined before and after boiling with a scanning electron microscope and it was found that boiling caused the polymer coated surfaces to change. In some cases, the polymer coated surfaces cracked, and small pieces of polymer were lifted from the surface while on other surfaces the polymer was eroded. However in two cases, the polymer coating cracked and part of the polymer was lifted off the surface. Dissert. Abstr.

DATA SUMMARY: Data summary not prepared due to nonavailability of complete document for processing.

N77-15182 Ohio Univ., Athens.
COMPARISON OF PROCESSING CONDITIONS AFFECTING ORIENTATION IN FREE AND FIXED BOUNDARY EXTRUSION PROCESSES Ph.D. Thesis
Jonathan Marc Newcome 1976 257 p
Avail: Univ. Microfilms Order No. 76-27253

The mechanical properties of flown film were investigated with respect to free flow variables and the capillary crystallization process was studied in terms of the effect on constrained flow dynamics on a crystallizing polymer. A low melt index (0.73) HDPE resin was flown under various conditions of take-up rate, blow-up ratio, extruder output and bubble cooling, and subjected to tensile evaluation in order to determine the predominating variable(s) upon mechanical properties. The severity of the bubble shape or contour within the necked zone of deformation was also considered in attempts to correlate strain rate and mechanical property trends. A special reservoir/die assembly of cylindrical geometry was used to generate experimental data for comparison with the mathematical modeling of heat and momentum transfer in a polymer flowing and crystallizing within the lands of the die. Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-15183 Rutgers Univ., New Brunswick, N.J.
THE STUDY OF BARRIER ACTION OF POLYMERIC FILMS: AN INFRARED APPROACH Ph.D. Thesis
Kenneth Steven Marsh 1976 91 p
Avail: Univ. Microfilms Order No. 76-27023

A spectrophotometric method was developed whereby the barrier parameters of diffusivity, solubility, and permeability could be rapidly measured for any infrared active sorbant and virtually any polymer in a variety of sorbant-polymer systems. A cell was designed and constructed which allows determinations to be made over a large range of temperatures and pressures. The

method was applied to a family of acrylonitrile based polymers using carbon dioxide as the sorbant gas. The measured parameters showed good agreement with data obtained elsewhere. A series of desorption scans was taken at various temperatures for each polymer. The temperature dependency gave evidence of a polymer-sorbant interaction mechanism. High resolution infrared spectral scans of sorbed polymers showed a peak that could be interpreted as evidence of a carbon dioxide-nitrile interaction.
Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-15184 Rensselaer Polytechnic Inst., Troy, N.Y.
SURFACE ANALYSIS AND ADHESION IN FLUOROPOLYMERS Ph.D. Thesis
David Walter Dwight 1976 93 p
Avail: Univ. Microfilms Order No. 76-27192

By combining X-ray photoelectron spectroscopy, contact-angle hysteresis, and electron microscopy, a powerful method to elucidate the nature of solid surfaces was created. X-ray photoelectron spectroscopy provides semi-quantitative elemental analysis of the uppermost tens of Angstrom units of the sample. A view of the microtopography is obtained with the electron microscope and contact-angle hysteresis can be interpreted in terms of the distribution of surface energies and roughness. This method of surface characterization is especially useful for fluoropolymers. A semi-empirical way to elucidate adhesive bonding phenomena was based on the surface analysis method and guided by qualitative fracture mechanics theory.
Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-15185 Missouri Univ., Rolla.
A MECHANISTIC AND STRUCTURAL INVESTIGATION OF PLASMA-POLYMERIZED ETHYLENE Ph.D. Thesis
Marvin Russell Havens 1976 171 p
Avail: Univ. Microfilms Order No. 76-26861

In the plasma polymerization of ethylene, the plasma itself was probed for clues about the reaction mechanism and properties of the products. Some of the tools and techniques developed and applied include a quartz crystal microbalance, a monopole mass spectrometer, a new low-angle X-ray analysis method, and both transmission and scanning electron microscopy. The data led to postulating a cationic polymerization mechanism involving acetylene as the predominant species. Depending upon the location within the bulk volume of the reactor where this active species is formed, the polymerization steps proceed to produce either a relatively high-density, spherical particle or a lower density filler material, both of which are integrated into the product film.
Dissert. Abstr.

DATA SUMMARY: Data summary not prepared due to nonavailability of complete document for processing.

N77-15186 Missouri Univ., Rolla.
MECHANICAL DEGRADATION OF POLYMERS IN DILUTE SOLUTIONS Ph.D. Thesis
John Dougherty Culter 1976 213 p
Avail: Univ. Microfilms Order No. 76-26856

The effect of polymer molecular structure on degradation in laminar flow of dilute solutions was studied in both capillaries and in a rotating ring degradation system. In addition to structure, an attempt was made to determine the effect of shear stress, concentration, solvent viscosity, polymer-solvent interaction, and molecular weight distribution. A large portion of the study was concerned with building a laminar flow, high shear rate instrument. The degradation results in the capillar system in laminar flow indicated that the degradation occurred mainly in the entrance region because no length effect was found. In the rotating ring, the flow field was found to be strongly influenced by centrifugal forces. The results showed the existence of a critical shear stress which must be exceeded to cause degradation. The largest polymer species remaining after degradation could be correlated with the ratio of the shear stress to the critical shear stress.
Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-15187 Polytechnic Inst. of New York, Brooklyn.
A STUDY OF THE PHOTOCHEMISTRY OF CHROMOPHORES IN THE BACKBONE OF FLEXIBLE POLYMER CHAINS Ph.D. Thesis
David Ta-Li Chen 1976 191 p
Avail: Univ. Microfilms Order No. 76-23397

Three types of azocopolymers having a different backbone structure and flexibility were prepared. The relative quantum yield of trans yield cis photoisomerization of these copolymers containing a small amount of azobenzene residues in the chain backbone was compared to their corresponding low molecular weight model compounds in dilute solutions, solvent mixtures, viscous solutions, concentrated homopolymer solutions, and in polymer matrices as a function of their plasticizer content. In dilute solutions, the copolymers and model compounds behaved similarly and no effect of chain rigidity was observed on the rate of photoisomerization. This observation suggested that two correlated transitions are not necessary for conformational transitions of long chains even if the energy barrier for the hindered rotation is low. This seems to contradict the assumption of a crankshaft-like mechanism.
Dissert. Abstr.

DATA SUMMARY: Data summary not prepared due to nonavailability of complete document for processing.

N77-15188 Dartmouth Coll., Hanover, N.H.
MAGNETIC RELAXATION STUDY OF POLYMER CHAIN MOTIONS Ph.D. Thesis
Henry Wu-Hsiang Yang 1976 150 p
Avail: Univ. Microfilms Order No. 76-27265

Using the method of magnetic relaxation, the local motions of polymer chains in dilute solution were investigated. The dependence of the spin-lattice relaxation time T sub 1 and the nuclear Overhauser effect NOE on temperature, concentration, solvent viscosity, molecular weight, and field strength were explored. Various techniques were used to measure T sub 1, but the pulse method was emphasized. It was generally found that both T sub 1 and NOE decreased to an asymptotic value as molecular weight increased. Also, they both decreased with increasing concentration as the result of the intermolecular dipole-dipole interactions. At high temperatures or in solvents with lower viscosities, T sub 1 increased because of faster molecular motion. A theoretical model based on a 3-bond crankshaft motion in a tetrahedral lattice with limited coupling between sequences of backbone bonds was successfully employed in describing polymer backbone motions. Very good agreement with experiment was found.
Dissert. Abstr.

DATA SUMMARY: Data summary not prepared due to nonavailability of complete document for processing.

N77-15189*# Kanner (Leo) Associates, Redwood City, Calif.
MEASUREMENT OF THE T1T2 PRODUCT OF THE RELAXATION TIME OF CARBON AS A FUNCTION OF TEMPERATURE AT A FREQUENCY OF 34.6 kMc
J. Conard Washington NASA Dec. 1976 7 p refs Transl. into ENGLISH from Compt. Rend. (France), v. 257, no. 26, 1963 p 4160-4162
(Contract NASw-2790)
(NASA-TT-F-17326) Avail: NTIS HC A02/MF A01 CSCL 11G

The saturation method was used to measure the product, T sub 1 T sub 2, of a coal sample pyrolyzed at 400 C. The measurements were made under He (300 and 77 K) and in a liquid helium bath (4 K). The T sub 1 T sub 2 product of the relaxation time was calculated by the Portis theory. The rotating field, H sub 1, in the cavity is related to the incident power, P, by the relation (H sub 1) sup 2 = .0041 QP, with P given in w, H in gauss, for the rectangular cavity, H sub 012, at the 0.86-cm wavelength used. The relaxation time, T sub 1, varied slightly with temperature in the 8-mm band, whereas it increased more than 1000 times in passing from 3000 to 12,000 oe. The slight variation of T sub 1 with temperature indicates that the exchange interaction is strong enough to enable the exchange

energy to assume the role of a thermostat, at least partially.
Author

DATA SUMMARY: Results of relaxation experiments performed on pyrolyzed charcoal; variables include temperature, absorption, rotating field (gauss); 1 figure and 1 table include numeric data.

N77-15190# Materials Research Labs., Maribyrnong (Australia).
THE ADHESION OF SILICA REINFORCED NATURAL RUBBER TO POLYETHYLENE
C. E. M. Morris Jun. 1976 50 p refs
(MRL-R-667; AR-269) Avail: NTIS HC A03/MF A01

The adhesion of natural rubber to polyethylene, using three samples of hydrated silica of different particle size to reinforce the rubber, was examined. Laminates were made, without an intermediate adhesive layer, by injection or compression molding, and the adhesion assessed, in the majority of cases, by peel tests, although some tensile and tensile-shear tests were also performed. The strength of adhesion was found to depend on the particle size of the silica and on the physical properties of the rubber samples. An influence of the magnitude of the coefficient of thermal expansion above the glass transition of the rubber samples on the adhesion strength was also noted.
Author

DATA SUMMARY: The adhesion strength of three hydrated silicas of different reinforcing ability was tested at various loadings up to 65 parts per hundred parts of rubber, by weight (phr); variables include tensile strength, modulus at 300% elongation, elongation at break, hardness, cure time, silica loading, peel force, thickness, additives-paraffin wax, polyethylene glycol, and coefficient of thermal expansion; 12 figures and 10 tables include numeric data.

N77-15191# Materials Research Labs., Maribyrnong (Australia).
WEATHERING OF FILAMENT-WOUND GLASS-EPOXY TUBES
John G. Williams May 1976 23 p refs
(MRL-R-662; AR-265) Avail: NTIS HC A02/MF A01

Filament-wound glass-epoxy tubes manufactured for use as a rocket-launcher component were used to study weathering of unstressed composites in a hot-wet environment. Tubes were exposed in three forms: as wound; after grinding to a fixed diameter; and after coating with alkyd paint. Burst pressure and torsional rigidity tests were used to study the mechanical effects of degradation. No significant deterioration could be detected mechanically after exposure in an unstressed state for two years. Minor loss of superficial glass fiber was observed on ground, uncoated specimens, but this relatively small deterioration was prevented by the use of the standard coating system. Author

DATA SUMMARY: Burst pressure of as-wound and ground tubes; variables include environmental factor, withdrawal period, torsional rigidity, tube type, length, mean pressure, standard deviation, and hydrostatic burst pressure; 4 tables include numeric data.

N77-15192*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
POLYIMIDE ADHESIVES Patent Application
Donald J. Progar, Vernon L. Bell, and Terry L. StClair, inventors (to NASA) Filed 22 Oct. 1976 14 p
(NASA-Case-LAR-12181-1; US-Patent-Appl-SN-734901) Avail: NTIS HC A02/MF A01 CSCL 11A

A process of preparing aromatic polyamide-acids is described for use as adhesives by reacting an aromatic dianhydride to an approximately equimolar amount of an aromatic diamine in a water or lower alkanol miscible ether solvent. The polyamide acids are converted to polyimides by heating to the temperature range of 200 - 300 C. The polyimides are thermally stable and insoluble in ethers and other organic solvents. NASA

DATA SUMMARY: Five polymerization solvents and 3 resins were tested for TI-TI lap shear strengths; variable includes lap shear strength; 2 tables include numeric data.

N77-15193*# Kanner (Leo) Associates, Redwood City, Calif.
MAGNETIC SUSCEPTIBILITY OF ANTHRACENE CARBONS TREATED BETWEEN 600 AND 1200 DEG
A. Marchand, F. Boy, and A Forchioni Washington NASA Dec. 1976 18 p refs Transl. into ENGLISH from J. Chim. Phys., v. 59, 1962 p 1259-1266
(Contract NASw-2790)
(NASA-TT-F-17349) Avail: NTIS HC A02/MF A01 CSCL 11D

The magnetic susceptibility of a series of carbons prepared from anthracene by pyrolysis at 600-1200 deg was studied. At lower treatment temperatures (HTT < 900 deg), the variation of the mean magnetic susceptibility (chi) with temperature shows that the paramagnetic centers are localized: their paramagnetism closely follows the Curie law, with the exception of an unusual increase in paramagnetism observed in some cases around 80 K. The increase in diamagnetism observed at HTT > 800 deg corresponds to an increase of the absolute value of chi sub d, despite the disappearance of paramagnetic centers, which reach their maximum concentration at HTT = 700 deg. This increase of the absolute valve of chi sub d indicates the onset of graphitization, or at least a progressive reorganization of carbon atoms as an aromatic condensed lattice of increasing dimensions. Author

DATA SUMMARY: Characteristics of anthracene and acridine carbon after chemical treatment and pyrolysis; variables include magnetic susceptibility, temperature, time; 9 figures and 4 tables include numeric data.

N77-15194# Sandia Labs., Albuquerque, N.Mex.
EFFECTS OF GAS TRANSPORT PROPERTIES ON BLISTER FORMATION IN He(+)-IMPLANTED GLASS
P. L. Mattern, J. E. Shelby, G. J. Thomas, and W. Bauer Feb. 1976 26 p refs Presented at the 2d Intern. Conf. on Surface Effects in Controlled Fusion Devices; San Francisco, 16-20 Feb. 1976
(Contract AT(29-1)-789)
(SAND-75-8758; Conf-760209-25) Avail: NTIS HC A03/MF A01

Measurements are reported on He(+) implanted glasses which have diffusivities at 110 to C from approximately 3 x 10 to the - 7th power to approximately 7 x 10 the -12th power sq cm/sec. The occurrence, size, and density of blisters are correlated with He gas diffusivity. Reemission data are compared with results from a simple theoretical model. Implications for CTR technology are discussed. ERA

DATA SUMMARY: He(+) implantations of glass were carried out with a 150 keV, 15 micron A/sq cm beam continuously incident on the samples until a fluence of 1.0 x 10 to the 18th power He(+)/sq cm had been reached; variables include diffusivity, temperature, blister formation, mole percent Li2O, reemission fraction, and fluence; 3 figures include numeric data.

N77-15195# Oak Ridge Y-12 Plant, Tenn.
GLASS TRANSITION TEMPERATURES OF EPOXY RESINS BY PULSED NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY
A. C. Rutenberg, G. F. Dorsey, and C. G. Peck 21 Apr. 1976 28 p refs
(Contract W-7405-eng-26)
(Y-2015) Avail: NTIS HC A03/MF A01

Measurements make it possible to monitor the cure and determine the glass transition temperature as a function of the curing conditions and the concentration of the components. Knowledge of the glass transition temperature of the cured epoxies allows screening of them for a number of uses, including adhesives and coatings operations. ERA

DATA SUMMARY: Six commercial epoxy resins are characterized; variables include time, temperature, equivalent weight, viscosity, hardness, and curing conditions; 2 figures and 9 tables include numeric data.

N77-15196# Technology, Inc., Dayton, Ohio.
COMPOUNDS AND PROPERTIES OF THE Si-Al-O-N SYSTEM Interim Report, 1 Oct. 1973 - 1 Oct. 1975

Peter L. Land, J. M. Wimmer, R. W. Burns, and N. S. Choudhury
Wright-Patterson, AFB, Ohio AFML Apr. 1976 79 p refs
(Contract F33615-71-C-1463; AF Proj. 7021)
(AD-A026520; AFML-TR-75-209) Avail: NTIS HC A05/MF A01 CSCL 11/2

A product or quasi-equilibrium diagram for compounds formed in the system Si-Al-O-N at 1800 C in 1 atm N2 is presented. X-ray diffraction spectra for several new phases are given and the reaction and sintering processes are discussed. Data for the lattice expansion of the Beta-Si3N4 structure accompanying the incorporation of Al and O is presented, and used to calculate theoretical densities. Author (GRA)

DATA SUMMARY: Firing conditions and compositions of green bodies and the effects of these variations on the physical properties and composition of the resulting SiAlON bodies; variables include firing position, firing temperature, % weight change, % diameter change, weight % composition of product, Cukalpha diffraction spectra, beta-SiAlON lattice parameters, oxygen content, crystalline phase, surface area; 14 figures and 10 tables include numeric data.

N77-15197# Block Engineering, Inc., Cambridge, Mass.
THE DETECTION OF RF DAMAGE TO HIGH MOLECULAR WEIGHT BIOPOLYMERS BY RAMAN SPECTROSCOPY Final Comprehensive Report, 1 Jun. - 1 Sep. 1975
Charles A. Cody, Anthony J. Modestino, Philip J. Miller, and Stanley M. Klainer 9 Jan. 1976 78 p refs
(Contract F41609-75-C-0043)
(AD-A027049; BEI-75-648) Avail: NTIS HC A05/MF A01 CSCL 06/18

The program undertaken under this contract was designed to investigate Raman and infrared spectrometric techniques as a method of detecting, quantifying and diagnosing molecular damage in biological compounds due to exposure to RF (radio frequency) radiation. The program emphasis was on the use of the Raman approach while only a preliminary evaluation of the infrared method was undertaken. It has been established that biological materials do undergo damage when exposed to RF radiation. It has further been concluded that molecular spectroscopy methods yield the data output necessary to generate RF radiation hazard parameters. The spectrometric approaches, however, have not been fully developed or refined. In the case of Raman spectroscopy fluorescence and sensitivity are problems. Infrared techniques appear satisfactory from preliminary data but the effect of the water-rich background matrices and the ability to do micro-damage assessment are not completely known.GRA

DATA SUMMARY: Raman spectra of 6 irradiated and nonirradiated biological molecules; variables include frequency, electric field strength, time of irradiation, and absorbance; 26 figures include numeric data.

N77-15198# Alabama Univ., Birmingham. Dept. of Biomaterials.
RESPONSE OF COMBINED ELECTRICAL STIMULATION AND BIODEGRADABLE CERAMIC Annual Report, 1975 - 1976
J. E. Lemons 29 Dec. 1975 39 p refs
(Contract DAMD17-75-C-5044)
(AD-A027631; AR-1) Avail: NTIS HC A03/MF A01 CSCL 06/5

This report presents a summary of the methods and results for 8 months of the first year investigation on the kinetics and tissue response of combining biodegradable porous ceramics and electrical stimulation for the correction of surgical defects in bone. Comparisons of healing characteristics of surgical lesions along rabbit tibias (5 control, 5 tricalcium phosphate and 5 tricalcium phosphate plus electrical stimulation) at 3, 6, and 12 weeks have shown considerable promise for this synthetic biomaterial and methodology. The animal model and evaluation techniques appear quite adequate for qualitatively and quantitatively evaluating the experimental conditions. Microscopy studies of the ceramic samples from the two sources showed differences in the microstructural dimensions of the porosity. Pore size distribution measurements showed the pore dimensions to extend from below 10 to above 600 micrometers with the average near 200 micrometers. The animal surgery and post operative follow-up proved routine after several specialty techniques were developed. Radiography and necropsy showed callus development associated with the synthetic biomaterial and most of the stabilization devices were removed after 6 weeks. Biomechanical strength tests showed similar magnitude strengths at each time period with a general increase in strength with time. GRA

DATA SUMMARY: Conditions required to fracture bones implanted with calcium phosphates, some stimulated with electrical current; variables include duration of experiment, load at fracture, work to fracture; 1 table includes numeric data.

N77-15199# Ceramic Finishing Co., State College, Pa.
LOCALIZED IMPACT DAMAGE IN CERAMICS. A: LOCALIZED IMPACT DAMAGE IN GLASS. B: LOCALIZED IMPACT DAMAGE IN STRESSED MEMBERS
Henry P. Kirchner and Robert M. Gruver Jun. 1976 48 p refs
(Contract N00014-74-C-0241; NR Proj. 032-545)
(AD-A027169; TR-4) Avail: NTIS HC A03/MF A01 CSCL 11/2

This technical report discusses (1) Localized Impact Damage in Glass -- Glass plates were impacted by glass, steel and NYLON spheres at velocities up to 115 m/s. The impact sites were characterized and the remaining strengths were measured. Hertz cone crack depths were found to be much less than theoretical estimates. The cone angles increased with increasing impact velocity. Evidence of crack branching of cone cracks, and radial and lateral vent crack formation was observed at high impact velocities. (2) Localized Impact Damage in Stressed Members Glass plates were stressed biaxially in flexure and impacted by glass spheres. The impact sites were characterized - Impacts on tensile surfaces initiated damage at lower velocities and showed enhanced penetration compared with those on compressive surfaces. Author (GRA)

DATA SUMMARY: Results of impact tests on glass plates; variables include impact velocity, hertz crack radius, impact force, flexural strength, contact radius, cone angle, penetration, biaxial tensile strength; 9 figures and 1 table include numeric data.

N77-15200# Harry Diamond Labs., Adelphi, Md.
ALCOHOL-SENSITIVE EPOXY FORMULATIONS FOR TEMPORARY OR REPAIRABLE EMBEDMENT
Sheng Yen Lee and Keith C. Bruce Jun. 1976 26 p refs
(DA Proj. 1W6-62616-AH-77; HDL Proj. A77591)
(AD-A027555; HDL-TR-1757) Avail: NTIS HC A03/MF A01 CSCL 11/9

Repairable embedding epoxy formulations have been developed that are alcohol sensitive and hence can be readily removed with an alcohol without damage to the embedded components. The alcohol sensitivity is greatly enhanced with poly(N-vinyl-2-pyrrolidone) as filler. Some basic thermal, electrical, and mechanical properties of the cured epoxies were found to be satisfactory. Being inherently more hydrophilic than the regular epoxy, the materials are not intended for the continuous use in an environment of high humidity. For occasional exposures, a low filler level or an application of a protective thin coating of a regular epoxy is advisable. Author (GRA)

DATA SUMMARY: Behavior of poly(N-vinyl-2-pyrrolidone) and epoxy formulations; variables include weight loss, weight gain, temperature, gel time, cure time, immersion, time, hardness, humidity, volume resistivity; 9 figures and 15 tables include numeric data.

N77-15201# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
ANALYTICAL APPROACH TO THE CHARACTERIZATION OF MILITARY LUBRICANTS Interim Report
L. L. Stavinoha, G. E. Fodor, F. M. Newman, and S. J. Lestz Mar. 1976 43 p refs
(Contract DAAG53-76-C-0003)
(AD-A027397; AFLRL-77) Avail: NTIS HC A03/MF A01 CSCL 11/8

As an integral part of the Army's overall power train lubrication research effort, analytical/instrumental methods continue to be developed for use in determining compositional characteristics

of new lubricants and to detect unusual contaminants in new and used lubricants. Included among the various types of instruments being used in this work to characterize lubricants are: gas chromatography (GC), high performance liquid chromatography (reversed-phase, adsorption, gel-permeation), and spectrophotometry (IR, UV, AA, XRF). Methods to separate lubricants into component parts according to chemical types in order to simplify the subsequent analysis and identification of the component parts have been applied with favorable results. Characterization of lubricants to include additives is not yet complete. Ultimate refinements of this approach will provide the detailed compositional information needed to define base stock characterization, develop correlation of lubricant component to equipment performance, and identify sources of new, used, synthetic and re-refined lubricants, power train and hydraulic fluids. GRA

DATA SUMMARY: Physical properties and chemical analyses of lubricants and related compounds; variables include wavelength, transmittance, frequency, molecular weight, elution volume, % weight, temperature, retention time; 9 figures and 15 tables include numeric data.

N77-15202# Monsanto Research Corp., St. Louis, Mo.
DEVELOPMENT OF A GAS TURBINE ENGINE OIL FOR BULK OIL TEMPERATURES OF -40 TO 465 F, PART 2 Final Report, 1 Oct. 1974 - 22 Sep. 1975
F. S. Clark, J. F. Herber, and S. L. Reid Dec. 1975 46 p refs
(Contract F33615-73-C-5079; AF Proj. 7343)
(AD-A027068; MRC-SL-538-Pt-2; AFML-TR-74-247-Pt-2) Avail: NTIS HC A03/MF A01 CSCL 11/8

This contract involved advanced characterization of three MIL-L-27502 lubricants. These were ester blends designated MCS 1710, MCS 1709 and Fluid 12. Oxidation-corrosion and storage life tests were run on all fluids. Mil-L-27502 bearing tests were run on MCS 1710 and MCS 1709; each gave very good results. Moreover, both of these blends have satisfactory Ryder loads. Two hundred gallons of MCS 1710 plus a metal deactivator were blended and sent to AFML for further evaluation. The deactivator was added to reduce magnesium corrosion of MCS 1710. Author (GRA)

DATA SUMMARY: Oxidation-corrosion and bearing tests of 3 lubricating oils were conducted at 428 F and 464 F; variables include % viscosity increase, total acid number, oil consumption, metal weight change (mg/sq. cm.), filter sludge, time, temperature, and storage life; 4 figures and 17 tables include numeric data.

N77-15203# TRW, Inc., Cleveland, Ohio.
NONDESTRUCTIVE EVALUATION OF CERAMICS Final Technical Report, 20 Jan. 1975 - 19 Apr. 1976
T. Derkacs, I. M. Matay, and W. D. Brentnall 19 May 1976 130 p refs
(Contract N00019-75-C-0238)
(AD-A027357; TRW-ER-7798-F) Avail: NTIS HC A07/MF A01 CSCL 11/2

An ultrasonic nondestructive evaluation (UNDE) techniques was developed to successfully detect small defects in gas turbine quality ceramic materials. A high frequency (25-45 MHz), longitudinal wave mode, pulse-reflection UNDE method was developed to evaluate a range of densities (2.2 to 3.2 g/cc) of ceramics (reaction bonded Si3N4, sintered SiC, hot pressed Si3N4 and hot pressed SiC) for various types of defects (open pores and seeded inclusions of low (Al2O3) and high (WC) densities) of various small sizes (10 to 130 micrometers). Conventional mechanical tests were also performed to verify defect sizes and to correlate material strength with UNDE results. Author (GRA)

DATA SUMMARY: Ultrasonic inspection results of hot pressed and sintered silicon carbide and hot pressed and reaction bonded silicon nitride seeded with 125 micrometer low and high density particles in specified locations; variables include bulk density, flexural strength, fracture initiation, defect size and location distribution, stress rupture strength, temperature, time, sound propagation, resonant frequencies, and signal amplitude; 6 figures and 7 tables include numeric data.

N77-15204# Battelle Columbus Labs., Ohio.
FRACTURE STRESS AS RELATED TO FLAW AND FRACTURE MIRROR SIZES IN TWO POLYCRYSTALLINE CERAMICS Technical Report, Oct. 1975 - Apr. 1976
Girraj K. Bansal and Winston H. Duckworth May 1976 41 p refs
(Contract N00014-73-C-0408; NR Proj. 032-541)
(AD-A027698; TR-5) Avail: NTIS HC A03/MF A01 CSCL 11/2

Fractographically observed critical-flaw boundaries in strength-tested specimens of two polycrystalline ceramics were used in calculating critical stress-intensity factors. Each ceramic was found to exhibit a characteristic stress-intensity factor (K sub IC) having little or no dependence on critical-flaw characteristics. Also, the research indicated that microstructural inhomogenities (e.g., large grains or pores) which initiate fracturing can be significantly smaller than associated critical flaws. The fractographic interpretations of critical-flaw boundaries were supported by independent determinations of K sub IC using artificially precracked specimens and by analyses both of fracture-mirror sizes and of water-enhanced sub-critical crack growth data. The fracture-mirror analysis further indicated that the parameter, A K sub IC, where A is the fracture-mirror constant, is a dimensionless, material-independent constant that can be evaluated solely from fractographic observations. Author (GRA)

DATA SUMMARY: Strength tests and fractography of glass and aluminum oxide specimens; variables include Young's modulus, stress intensity factor, fracture surface energy, flaw size, fracture mirror size, flaw depth, strength, fracture stress, mirror radius, crack velocity; 4 figures and 3 tables include numeric data.

N77-15205# Harry Diamond Labs., Adelphi, Md.
WATER-VAPOR-BARRIER COATINGS FOR POLYURETHANE FOAMS
J. Michael Boyd and David VanDaalen Jun. 1976 14 p refs
(HDL Proj. A77591; DA Proj. 1W3-62616-AH-77)
(AD-A027556; HDL-TM-76-14) Avail: NTIS HC A02/MF A01 CSCL 11/3

The water-vapor transmission rates through a polyether type of polyurethane foam with and without vapor-barrier coatings were determined at 70 C and 91-percent relative humidity. The data indicate that polyurethane foam encapsulation cannot provide satisfactory protection from moisture penetration. The moisture transmission is more severe for low-density foam. Two low-molecular-weight, butyl-rubber coating materials and one epoxy compound were shown to form good coatings on the foam and resulted in 37- to 95-percent transmission-rate reductions when the coatings were nominally 0.020 in. thick. Author (GRA)

DATA SUMMARY: Water vapor transmission rates of polyurethane foam at 70 C and 91% relative humidity; variables include foam density, protective coatings, nominal thickness of coating; 3 tables include numeric data.

N77-15206# General Atomic Co., San Diego, Calif.
APPLICATIONS OF LOW ATOMIC NUMBER CERAMIC MATERIALS TO FUSION REACTOR FIRST WALLS Final Report
L. H. Rovner, R. F. Bourque, and K. Y. Chen Aug. 1976 130 p refs
(EPRI Proj. 115-2)
(PB-257573/6; EPRI-ER-216) Avail: NTIS HC A07/MF A01 CSCL 18J

The first wall of a fusion reactor must withstand the impact of energetic charged particles and photons escaping from the plasma as well as intense neutron flux. The design and materials selection for the first wall of a fusion reactor represents one of the critical problem areas for achievement of fusion power. It is shown that high energy ions can result in large effective sputtering coefficients and may contribute significantly to projected first wall erosion rates. GRA

DATA SUMMARY: Effects of MeV He(+) bombardment on carbon and silicon carbide surfaces; variables include bombardment dose, rate of surface layer removal, wall erosion, design

lifetime, front surface deflection, distance of liner from front surface, max. wall loading, thickness, and max. heat flux; 15 figures and 6 tables include numeric data.

N77-15207# National Bureau of Standards, Washington, D.C. Metallurgy Div.
THE ROLE OF COATINGS IN THE PREVENTION OF MECHANICAL FAILURES: PROCEEDINGS OF THE 23RD MEETING OF THE MECHANICAL FAILURES PREVENTION GROUP
T. R. Shives, ed. and W. A. Willard, ed. Sep. 1976 200 p refs Conf. Proc. held at Gaithersburg, Md., 29-31 Oct. 1975 Sponsored in part by the Office of Naval Research, Naval Air Development Center, Frankford Arsenal, and FAA
(PB-257422/6; NBS-SP-452; LC-76-608258) Avail: NTIS HC A09/MF A01 CSCL 11C

Papers are presented dealing with the preventing of mechanical failures. Emphasis is placed on polymer coatings, metal coatings, solid film lubricants, and chemical coatings. Author

DATA SUMMARY: Diverse data are presented; variables include heat treatment, temperature, time cycles to failure, friction coefficient, wear rate, thickness, hardness, fatigue life, fretting.

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers, storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N77-15208*+ National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BIBLIOGRAPHY ON LIQUEFIED NATURAL GAS (LNG) SAFETY
Paul M. Ordin Apr. 1976 654 p
(NASA-TM-X-73408; E-8715) Avail: NTIS HC A99 CSCL 21D

Approximately 600 citations concerning safety of liquefied natural gas and liquid methane are presented. Each entry includes the title, author, abstract, source, description of figures, key references, and major descriptors for retrieving the document. An author index is provided as well as an index of descriptors. Author

N77-15209# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
STUDY OF MIXTURES OF METHANE AND CARBON DIOXIDE AS FUELS IN A SINGLE CYLINDER ENGINE (CLR)
J. K. S. Wong Sep. 1976 32 p refs
(NRC-15636; MP-70; ISSN-0077-555X) Avail: NTIS HC A03/MF A01

A single cylinder four stoke engine (CLR) was used to investigate the feasibility of using mixtures of methane and carbon dioxide as an alternate fuel. Effects of fuel quality on engine power output and brake specific fuel consumption were investigated at 800, 1600, 2400, 2800, and 3200 rpm using full throttle setting with various spark timing, equivalence ratio, and maximum load. Results indicated that using fuel mixtures having quality of 65/35 or better in methane and carbon dioxide ratio along with optimum spark timing and operating equivalance ratio corresponding to maximum fuel economy, engine power losses, and brake specific fuel consumption increases could be kept below 10 percent compared to the maximum power produced with pure methane fuel. Author

N77-15210# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
PRODUCTION OF A HYDROCARBON-TYPE SYNTHETIC FUEL FROM WOOD
L. Gardner Sep. 1976 14 p refs
(NRC-15638; MP-71; ISSN-0077-555X) Avail: NTIS HC A02/MF A01

A theoretical study of the production of fuels from wood via pyrolysis and the Fischer-Tropsch synthesis was made. The results indicate that although technically feasible the production of such a fuel is financially and energy-wide uneconomical. Author

N77-15211# Materials Research Labs., Maribyrnong (Australia).
FORM-FUNCTIONS FOR MULTI-COMPONENT PROPELLANT CHARGES INCLUDING INHIBITED GRAINS AND SILVER BURN
J. Stals Sep. 1975 40 p refs
(MRL-TN-371; AR-266) Avail: NTIS HC A03/MF A01

Cubic form-functions in burning surface regression distance were derived and compiled for granulations that were used in current U.S.A., U.K., and Australian ammunition. Functions for specific inhibition of grain surface, silver burn for multiperforated grains, and unequal webs in seven perforated grains, were included. The functions were of general use in propellant grain design, closed-chamber and interior ballistic computations. Their resolution into igniter and propellant segment contributions as a function of grain surface regression, facilitated studies on multi-granular, multi-propellant charges, mortar charges, deterred grains, programmed or non-isochronous ignition, and the design of specific, or maximum progressivity granulations. Author

N77-15212# Committee on Aeronautical and Space Sciences (U. S. Senate).
ALTERNATIVE FUELS FOR AVIATION
Washington GPO 1976 187 p refs Hearings before Subcomm. on Aerospace Technol. and Natl. Needs of Comm. on Aeronaut. and Space Sci., 94th Congr., 2d Sess., 27-28 Sep. 1976
(GPO-78-544) Avail: SOD HC $1.90

Research and progress in the development of alternative fuels for aviation are discussed. The impact of using nonoptimum synthetic hydrocarbon based fuels on aeronautical structures and the cost of commercial airfares is explored. A.H.

N77-15213# California Univ., Irvine.
JP-4 AND JP-9 FUEL TOXICITY STUDIES USING WATER FISH AND AUFWUCHS Annual Research Report, 1 Jun. 1974 - 31 May 1975
Stephen Klein, Robert Cooper, and David Jenkins Jun. 1976 69 p refs
(Contract F33615-73-C-4059; AF Proj. 6302)
(AD-A027594; AMRL-TR-76-50) Avail: NTIS HC A04/MF A01 CSCL 21/5

This report contains the results of research efforts concerned with defining the effects of potential environmental contamination resulting from the use of certain Air Force materials on fresh water fish and aufwuchs. Materials evaluated include RJ-4, RJ-5, Methylcyclohexane, JP-9 and JP-4. Techniques for exposing organisms to those substances are discussed and the results of such exposures are presented. Author (GRA)

N77-15214# Monsanto Research Corp., Dayton, Ohio. Dayton Lab.
ENVIRONMENTAL DEGRADATION OF FUELS, FLUIDS AND RELATED MATERIALS FOR AIRCRAFT Final Report, 1 Dec. 1973 - 31 Jan. 1976
F. Neil Hodgson and A. M. Kemmer Mar. 1976 123 p refs
(Contract F33615-74-C-2002; AF Proj. 3048)
(AD-A026908; MRC-DA-539; AFAPL-TR-76-26) Avail: NTIS HC A06/MF A01 CSCL 21/4

Investigations of the composition and properties of a number of hydrocarbon fuels are described. Fuel analyses for hydrocarbon types, trace metals content, trace organic contaminants and elemental composition are presented. Studies of the fluorescence spectral properties of aircraft exhaust emissions are described, as is an investigation of the feasibility of using fluorometric measurements on fuels to supplement coker thermal stability data. An investigation of the experimental parameters of the hot manifold flammability test is discussed along with test results for various hydraulic fluids. Components recovered from aircraft crash sites have been examined to determine factors contributing to aircraft failure. Studies supporting Air Force programs for the formulation and specification development of high density fuels are presented. Author (GRA)

N77-15215# Exxon Research and Engineering Co., Linden, N.J. Government Research Lab.

EXTERNAL CATALYST BREAKUP PHENOMENA Final Report, Jun. 1974 - Jan. 1976

William F. Taylor, John D. Kuenzly (TRW Systems Group, Inc., Redondo Beach, Calif.), William T. Webber (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.), and Robert L. Sackheim (TRW Systems Group, Inc., Redondo Beach, Calif.) Edwards AFB, Calif. AFRPL Jun. 1976 416 p refs

(Contract F04611-74-C-0032)

(AD-A027217; EXXON/GRU.2BF.76; AFRPL-TR-76-47; AFRPL-TR-75-68) Avail: NTIS HC A18/MF A01 CSCL 21/9

The overall objective of the work in the program was to investigate the external breakup mechanisms of shell 405 catalyst so as to establish an understanding of the phenomenon in order to provide monopropellant hydrazine thruster designers with a fundamental technology base which they can use to achieve long life mission requirements. Following a review of the literature and other available information, twenty (20) different mechanisms or factors potentially significant to catalyst breakup were investigated either experimentally or analytically or by use of both techniques. Slightly more than half of the mechanisms investigated were found to have a significant influence on the complex phenomena involved in overall catalyst breakup. The significant primary catalyst breakup mechanisms were in general, associated with either pressure crushing forces or with various effects resulting from the presence of liquid hydrazine. A major secondary breakup mechanism is particle to particle abrasion which can occur if the catalyst in a voided bed experiences rapid motion. Another important factor in catalyst breakup is the deterioration as a result of thruster exposure of the ability of a fresh catalyst to resist the various breakup mechanisms. Results also indicate that the effect of the various mechanisms on the magnitude of breakup can be controlled by adjusting reactor operating variables such as liquid injection velocities, bed temperature, bed gas linear velocity and pressure drop, bed preload and catalyst selection for the various sections of a thruster and point to a number of variables or factors involved in thruster operation where operating envelopes or procedures could be developed to enhance catalyst life. GRA

N77-15216# Air Force Weapons Lab., Kirtland AFB, N.Mex.

SUMMARY OF NITROUS OXIDE INVESTIGATIONS Final Report

James K. Cawthra and M. Eisenstadt Jul. 1976 30 p refs

(AF Proj. 317J)

(AD-A027884; AFWL-TR-75-231) Avail: NTIS HC A03/MF A01 CSCL 07/2

The Air Force Weapons Laboratory (AFWL) proposes to use nitrous oxide (N2O) as an oxidizer in a combustion process for an airborne system. A number of problem areas were investigated by AFWL or by other organizations under contract to AFWL. This report summarizes the results of these N2O investigations. Two of the programs investigated the decomposition characteristics of N2O-CO mixtures. It was determined that the decomposition of gaseous N2O is not difficult to initiate, but that it is also easily quenched. Tests with the N2O-CO mixture revealed that this combination has significant explosive potential; however, it is difficult to initiate such an explosion. Another series of investigations addressed potential flow problems. The liquid N2O in the system is pressurized by helium in the ullage of the tank and absorbs some of this He. With more than about 0.5 mole percent absorbed He, the effective throat area of the cavitating venturi used in the metering system is appreciably reduced. A second aspect of the flow studies concerned the possibility of N2O solidification when it is dumped overboard under emergency airborne conditions. Tests confirmed the formation of N2O snow when liquid N2O was dumped into a vacuum chamber; however, no flow problems were encountered. The third group of tests evaluated materials compatibility with liquid N2O. A selection of 34 materials were immersed in liquid N2O, and three of the materials showed evidence of degradation. GRA

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

N77-15217*# National Aeronautics and Space Administration, Washington, D.C.

US METRIC STUDY MISSION TO THE UNITED KINGDOM AND THE FEDERAL REPUBLIC OF GERMANY: REPORT OF THE NASA REPRESENTATIVE (EXECUTIVE SUMMARY)

P. N. Vlannes Oct. 1976 8 p

(NASA-TM-X-74307) Avail: NTIS HC A02/MF A01 CSCL 05A

The trip report is given of the NASA representative of the U.S. metric study mission to the United Kingdom and the Federal Republic of Germany. The mission was organized and conducted under the aegis of the American National Metric Council to learn at first hand the progress of metrication in the United Kingdom and the progress of metrication in the aerospace industry in both the United Kingdom and the Federal Republic of Germany. Representatives of the mission included a cross section of government, industry, labor, and other segments of the private sector. After general and special meetings in the United Kingdom, U.S. members with aerospace related interests met with aerospace representatives in the Federal Republic of Germany. Author

N77-15218*# National Aeronautics and Space Administration, Washington, D.C.

US METRIC STUDY MISSION TO THE UNITED KINGDOM AND THE FEDERAL REPUBLIC OF GERMANY: REPORT OF THE NASA REPRESENTATIVE (FULL REPORT)

P. N. Vlannes Oct. 1976 65 p

(NASA-TM-X-74308) Avail: NTIS HC A04/MF A01 CSCL 05A

For abstract, see preceding accession.

N77-15219*# National Aeronautics and Space Administration. Pasadena Office, Calif.

MULTISTATION REFRIGERATION SYSTEM Patent Application

Ervin R. Wiebe, inventor (to NASA) (JPL) Filed 8 Sep. 1976 13 p

(Contract NAS7-100)

(NASA-Case-NPO-13839-1; US-Patent-Appl-SN-712981) Avail: NTIS HC A02/MF A01 CSCL 20D

A closed cycle refrigeration (CCR) system is disclosed for providing cooling at different temperatures to different parts of a maser. The CCR includes a first station for cooling the maser's parts, except the amplifier portion, to 4.5 K. The CCR further includes means with a 3.0 K station for cooling the maser's amplifier to 3.0 K and, thereby, increases the maser's gain and/or bandwidth by a significant factor. The means which provide the 3.0 K cooling include a pressure regulator, heat exchangers, an expansion valve, and a vacuum pump, which coact to cause helium, provided from a compressor, to liquefy and thereafter expand so as to vaporize. The heat of vaporization for the helium is provided by the maser amplifier, which is thereby cooled to 3.0 K. NASA

N77-15220# Naval Ship Research and Development Center, Bethesda, Md. Ship Performance Dept.

HYDRODYNAMIC EQUILIBRIUM CONDITIONS FOR AG(EH) MAIN STRUT-POD FOIL SYSTEM USING FLAP INCIDENCE CONTROL

D. W. Coder and B. B. Wisler, Jr. Jun. 1976 44 p refs

(AD-A027521; SPD-332-03; DTNSRDC-SPD-332-03) Avail: NTIS HC A03/MF A01 CSCL 13/10

The power requirements for hydrofoil craft control systems has been a subject of recent concern as the U.S. Navy considers larger and larger craft. Four hydrofoil configurations were investigated theoretically to determine power requirements to control a hydrofoil ship similar to the AG(EH) in a random sea, and a pivoted foil with leading-edge tab was found to consume the least power. To determine whether this configuration would actually consume the least power, a 1/12-scale model was examined for equilibrium flap/foil angle conditions (stable flying

situations) of the fully-wetted case. A passive control system comprised of mechanical linkages was used with the model to obtain steady-flow, fully-wetted conditions. The results of this experiment are discussed. GRA

N77-15221# Naval Weapons Center, China Lake, Calif.
PRACTICAL RISK ANALYSIS FOR SAFETY MANAGEMENT Final Report
G. F. Kinney and A. D. Wiruth Jun. 1976 21 p
(AD-A027189; NWC-TP-5865) Avail: NTIS HC A02/MF A01 CSCL 13/12

This report describes a practical risk analysis system which can be used for the quantitative characterization of risks and for the evaluation of proposed risk reduction procedures. The system uses numerical values for comparison purposes and provides descriptive terms that are meaningful to personnel in safety, operations, and management. The analysis functions are performed either algebraically or graphically on nomographs provided in the report. GRA

N77-15222# Naval Ship Research and Development Center, Bethesda, Md.
A PARAMETRIC SURVEY OF HYDROFOIL STRUT FLUTTER Final Report
Peter K. Besch and Edwin P. Rood, Jr. Jun. 1976 118 p refs
(ZF43421001)
(AD-A027188; DTNSRDC-76-0050) Avail: NTIS HC A06/MF A01 CSCL 20/4

In order to explore the fundamental nature of hydrofoil flutter, a hydroelastic instability which is a potential cause of structural failure of lifting surfaces operating at high speeds in water, a series of hydrofoil models was tested in a towing basin. Flutter data were obtained from four surface-piercing hydrofoil strut models with various pod and foil configurations. Flutter occurred in two independent hydroelastic modes having predominantly first bending and first torsion mode shapes, respectively. The unstable modes were found to exist simultaneously in at least one strut. Flutter inception speed of the bending flutter mode was affected by strut submergence and the presence or absence of a foil. Flutter inception speed of the torsional flutter mode was dependent on strut cavitation pattern, strut submergence, pod moment of inertia, pod length, and the presence or absence of a foil. Author (GRA)

32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking.*

N77-15223 Ohio Univ., Athens.
A STUDY OF DIFFRACTION OF ELECTROMAGNETIC WAVES AROUND LARGE STATIONARY AIRCRAFT AND ITS EFFECTS ON INSTRUMENT LANDING SYSTEM GUIDANCE SIGNALS Ph.D. Thesis
Robert Adrian Rondini 1976 208 p
Avail: Univ. Microfilms Order No. 76-27257

The basic scattering theory upon which the theoretical model was based is the vector extension of Kirchoff's diffraction integral for scalar fields. As applied to the problem of scattering of electromagnetic waves by a large aircraft, the solution of the resultant diffraction integral required that a number of simplifying assumptions be made in order to arrive at a numerical result. Mathematical justifications for using the simplifying assumptions were also presented. Dissert. Abstr.

N77-15224 Rensselaer Polytechnic Inst., Troy, N.Y.
MODELING OF IMPULSIVE NOISE AND ANALYSIS OF LINEAR AND NONLINEAR RECEPTION IN ELF/VLF NOISE Ph.D. Thesis
Bulent Sankur 1976 240 p
Avail: Univ. Microfilms Order No. 76-27207

A physical-statistical model of impulsive interference is developed and is applied to real world communication channels. The characteristics of observed impulsive noise processes are summarized and the main interference models that were proposed are discussed. A new model for narrowband impulsive noise is developed and the statistical properties of VLF noise (a subset of the overall model) are analyzed in detail. Characteristic functions and probability density functions of the envelope and phase as well as level crossing statistics are determined. A procedure was described to calibrate the proposed model against measured statistics of the noise. Dissert. Abstr.

N77-15225 Arizona Univ., Tucson.
SUPERRESOLUTION OF STRETCH RADAR SIGNALS USING PROLATE SPHEROIDAL WAVE FUNCTIONS Ph.D. Thesis
Dennis Carl Ghiglia 1976 274 p
Avail: Univ. Microfilms Order No. 76-26811

An investigation was conducted upon a particular class of synthetic aperture radar signals that may possess the necessary properties to allow superresolution by the prolate spheroidal wave function method. General concepts of synthetic aperture radar and resulution were explored to set the framework. The special class of radar signals with and without certain phase errors is discussed and visual examples given. The technique of analytic continuation using prolate spheroidal wave functions is presented so as to show its mathematical connection to the presently implemented means of digital processing and image formation. A number of digital processing systems of increasing complexity are analyzed in a manner that determines various constraints on the superresolution process. Dissert. Abstr.

N77-15226 Rensselaer Polytechnic Inst., Troy, N.Y.
DISTORTION AND ESTIMATION OF THE AUTOCORRELATION FUNCTION AND SPECTRUM OF A RANDOMLY SAMPLED SIGNAL Ph.D. Thesis
Paul Frederick Scott 1976 86 p
Avail: Univ. Microfilms Order No. 76-27209

The theory of random sampling is discussed. A method for predicting the autocorrelation function (ACF) and spectrum of the sampling process is examined. The random sampling process is described by its time varying mean sampling rate and the complete set of inter sample probability density functions. These results are then used to determine the autocorrelation function and spectrum of a signal after sampling. The theory predicts the ACF for both the stationary and nonstationary cases, and does not use any of the 'small deviation from equispaced sampling' assumptions required by many random sampling theories. Dissert. Abstr.

N77-15227 Wisconsin Univ., Madison.
OPTIMAL ALIGNMENT OF BEYOND-THE-HORIZON MICROWAVE ANTENNAS Ph.D. Thesis
Anthony Erich Sill 1976 133 p
Avail: Univ. Microfilms Order No. 76-20136

A method was described for precisely aligning troposcatter antenna beams along the great circle path. The technique was based on achieving a symmetrical Doppler spectrum rather than on maximizing the total received power. Spectral symmetry or lack thereof was measured by the crosscorrelation function of the quadrature components of the complex envelope of the received signal. A crosscorrelation function which was odd indicates misaligned antennas, while one identically zero indicated either proper antenna alignment or beams symmetrically straddling the great circle. The latter case was corrected by defocusing one antenna and synchronously swinging the beams until the crosscorrelation function again vanishes. Also described were simple signal processing techniques which indicate Doppler spectrum symmetry without having to compute either the Doppler spectrum or the crosscorrelation function of the quadrature components of the complex envelope. Dissert. Abstr.

N77-15228 North Carolina State Univ., Raleigh.
RESONATOR CONTROLLED MICROWAVE SOURCES Ph.D. Thesis
June Singletary, Jr. 1976 77 p
Avail: Univ. Microfilms Order No. 76-28517

The equations for oscillation of a resonator feedback source, composed of a microwave amplifier with a two-port resonator

in the feedback path, were derived in terms of admittance parameters. The oscillation equations were then generalized to account for saturation of the amplifier and the effects of temperature change on the amplifier and resonator. The stability equations were then simplified in order to exhibit the more important amplifier and resonator parameters that determine the source temperature stability. A low expansion resonator was fabricated from titanium silicate glass. It was experimentally characterized both in terms of the resonant frequency, Q and coupling coefficients and in terms of scattering parameters. The temperature stability of the resonator was also measured.
Dissert. Abstr.

N77-15229 Missouri Univ., Rolla.
PROPAGATION DISTANCE OF SURFACE ELECTROMAGNETIC WAVES ON TWO METAL-OXIDE-AIR SYSTEMS Ph.D. Thesis
David Alan Bryan 1976 62 p
Avail: Univ. Microfilms Order No. 76-26853

The propagation distance of surface electromagnetic waves on a copper cuprous oxide air system was measured using two prism couplers, for oxide thicknesses between 20 A and 2000 A, and wavelengths from 9.2 micrometers to 10.8 micrometers. The copper sample consisted of an evaporated copper film on glass, with an oxide film overlayer grown by heating in air. The measured values of propagation distance agree well with computer calculated solutions of the three media dispersion relation. Similar measurements made on a polished surface of rolled titanium, oxidized by heating in air, give agreement only to within 50%. Auger analysis indicated that a carbide impurity on the highly reactive titanium surface and a variation of the titanium oxide composition with thickness both contributed to the disagreement between measured and calculated values of propagation distance. Dissert. Abstr.

N77-15230 Minnesota Univ., Minneapolis.
EXPLORER 45 OBSERVATIONS OF ULF WAVES IN THE MAGNETOSPHERE Ph.D. Thesis
Chen-Chang Lin 1976 227 p
Avail: Univ. Microfilms Order No. 76-27908

The observations of ultralow frequency waves in the magnetosphere near L = 5 from the Explorer 45 satellite are examined. The satellite observations of the pulsations are confined to the late afternoon and the evening sectors of the magnetosphere. World-wide ground magnetic records are used to investigate the correlations between the waves measured near the equator at the satellite and the waves measured on the ground. Pi 2 pulsations which began abruptly were observed at the satellite (in the evening quadrant) during 7 of the 13 substorms studied. These same substorms were identified in ground level magnetograms for auroral zone low latitude stations. The 7 Pi 2 pulsation events were also observed on the ground and 6 were identified by station observers as Pi 2. The occurrences of the Pi 2 pulsations were near the estimated time of substorm onset. Dissert. Abstr.

N77-15231 Wisconsin Univ., Madison.
THE TRANSFER OF THERMAL MICROWAVES THROUGH HYDROMETEORS Ph.D. Thesis
Richard Cyril Savage 1976 162 p
Avail. Univ. Microfilms Order No. 76-20689

The radiative transfer equation, including scattering but without polarization effects, is solved by several applications of the discrete ordinate method of Chandrasekhar. Results are presented for several raincloud depths and liquid water contents over both land and ocean surfaces in a standard atmosphere. The upwelling brightness temperatures are found to be functions of the physical temperatures at the top of the rain shaft, the species of hydrometeor in the raincloud, the liquid water content, and the drop size distribution. Dissert. Abstr.

N77-15232# Aerospace Corp., Washington, D.C.
ON PHASE DISTORTION IN LINEAR SYSTEMS Final Report
R. Kenneth Keenan Aug. 1976 42 p refs
(Contract DOT-FA71WA-2577)
(AD-A031166/2; FAA-RD-76-156) Avail: NTIS HC A03/MF A01 CSCL 17/2

The general problem of analytically defining and numerically quantifying the effects of phase distortion given a specified amplitude response is considered. A numerical example pertinent to the AEROSAT wideband communications/navigation channel is given. Additionally, it is shown that, for systems employing correlation detection techniques and meeting certain (practical) criteria, the effects of phase distortion can be determined in a straightforward manner. The magnitude of these effects is believed to be less than that implied by the usual effort expended in specifying satellite differential group delay, but the numerical computations to prove this point have not been carried out.
Author

N77-15233*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
DUAL FREQUENCY CIRCULARLY POLARIZED MICROWAVE INTEGRATED ANTENNA Patent Application
I-Ping Yu, inventor (to NASA) (Lockheed, Houston, Tex.) Filed 15 Dec. 1976 20 p
(Contract NAS9-12200)
(NASA-Case-MSC-16100-1; US-Patent-Appl-SN-750796) Avail: NTIS HC A02/MF A01 CSCL 17B

An antenna assembly operable in two frequency ranges is provided by using microstrip construction to obtain a first planar antenna element circumscribed by a second planar antenna element, each fitted with appropriate phase shifters. The geometry of the two antenna elements is utilized to couple the antenna assembly with selected impedance matching. NASA

N77-15234*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STATISTICS OF RAIN-RATE ESTIMATES FOR A SINGLE ATTENUATING RADAR
Robert Meneghini Dec. 1976 41 p ref Submitted for publication
(NASA-TM-X-71257; X-953-76-289) Avail: NTIS HC A03/MF A01 CSCL 17I

The effects of fluctuations in return power and the rain-rate/reflectivity relationship, are included in the estimates, as well as errors introduced in the attempt to recover the unattenuated return power. In addition to the Hitschfeld-Bordan correction, two alternative techniques are considered. The performance of the radar is shown to be dependent on the method by which attenuation correction is made. Author

N77-15235*# Motorola, Inc., Scottsdale, Ariz. Government Electronics Div.
ORBITER KU-BAND TRANSMITTER Final Report
R. Halterman 30 Nov. 1976 49 p
(Contract NAS9-14942)
(NASA-CR-151156; PIA-2216) Avail: NTIS HC A03/MF A01 CSCL 17B

The design, build, and test of an engineering breadboard Ku band quadraphase shift keyed and wideband frequency modulated transmitter are described. This orbiter Ku band transmitter drawer is to simulate the orbiter transmitter and meet the functional requirements of the orbiter communication link. Author

N77-15236*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A CW ULTRASONIC BOLT TENSIONING MONITOR Patent Application
Joseph S. Heyman, inventor (to NASA) Filed 23 Dec. 1976 22 p
(NASA-Case-LAR-12016-1; US-Patent-Appl-SN-754066) Avail: NTIS HC A02/MF A01 CSCL 20N

This invention is a CW ultrasonic device for measuring frequency shifts of the peak of a mechanical resonance in a body. One application of the device is measuring the strain in a bolt. It also has other applications, such as measuring the thickness, the depth of a flaw, the elongation, and changes in velocity of sound in a body. The body is connected, by means of a CW transducer, to electrical circuit means including a narrow band RF amplifier to form a closed loop feedback marginal oscillator that frequency locks the device to the peak of a mechanical resonance in the body. When the frequency of this peak changes, because of a physical change in the body, the frequency of the oscillator changes. The device includes an

automatic frequency resonant peak tracker that produces a voltage that is related to a change in frequency of the oscillator. This voltage is applied to the RF amplifier to change the center of its frequency band to include the frequency of the peak and is a measure of the frequency shift. NASA

N77-15237*# Baker (James L.) Development Corp., Sherwood Forest, Md.
LOCATE AND RESCUE SYSTEM COMPONENTS Final Report, period ending 15 Jun. 1976
Jul. 1976 67 p refs
(Contract NAS5-22953)
(NASA-CR-144836) Avail: NTIS HC A04/MF A01 CSCL 17B

Two types of search and rescue systems not involving satellites are studied; one using a network radio communications link and the other a characteristic beacon signal. Line of slight limitation of VHF radio and beacon signals limit the range (approximately 25 miles) between the origin of the distress signal and the mobile rescue unit. Author

N77-15238# Defense Systems Management School, Fort Belvoir, Va.
TESTING OF AUTOMATIC COMMAND AND CONTROL SYSTEMS
James R. Ervin Nov. 1975 39 p refs
(DSMS Proj. PMC-75-2)
(AD-A027021) Avail: NTIS HC A03/MF A01 CSCL 09/2

The purpose of the study project was to investigate the testing and evaluation of the software components of automatic command and control (C and C) systems, focusing on the Army Air Defense Command and Control System AN/TSQ-73 (Missile Minder). The scope was limited to the problems peculiar to the testing of C and C systems, current methodology for program and system testing, and the application of current methodology to testing the AN/TSQ-73. GRA

N77-15239# Rome Air Development Center, Griffiss AFB, N.Y.
AN/FPS-85 SYNCHRONOUS CAPABILITY, VOLUME 1, PART 1
Edward Malowicki and John A. Manley Jun. 1976 51 p refs
(AF Proj. 6512)
(AD-A026894; RADC-TR-76-34-Vol-1-Pt-1) Avail: NTIS HC A04/MF A01 CSCL 17/9

A study was conducted to determine the feasibility of extending the AN/FPS-85 radar performance to synchronous ranges. Several modifications involving mixed integration, coherent integration, and transmit power increases were examined considering the target effects of six typical objects and considering the Faraday rotation propagation effects. It was concluded that the An/FPS-85 radar can achieve synchronous capability at a relatively modest cost and with varying levels of radar time penalty depending upon the modification and target of interest. GRA

N77-15240# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
THE BASIC THEORY OF PHASED ARRAYS WITH A DISCUSSION OF THE BLIND ANGLE M.S. Thesis
Lawrence David Becker (Ill. Univ.) May 1976 84 p refs
(AD-A026712; AFIT-CI-76-68) Avail: NTIS HC A05/MF A01 CSCL 17/9

This report reviews the underlying theory of the phased array and then examines one of its most limiting problems--the blind angle. The theory of the phased array is developed by studying a simple two element array and then progressing to multi-element arrays. Following this, the progressive phase shift is incorporated into the driving currents and its result examined. The blind angle phenomenon is presented and then a physical reason for its occurrence is sought. The mutual coupling concept is demonstrated by examining mutual impedance as a function of spacing. Then the two predominate theories, surface wave and modal, offering a physical insight into the phenomenon are examined. Considerable attention is devoted to the 'Ghost Mode Hypothesis' of Oliner, et al. and the work of Louis Stark. Author (GRA)

N77-15241# Facility Checking Squadron (1868th) (AFCS), APO New York 09332.
RADAR SPECIAL EVALUATION REPORT: DEGRADATION OF AN/UPX-6 INTERROGATOR SET IDENTIFICATION FRIEND OR FOE/SELECTIVE IDENTIFICATION FEATURE IFF/SIF RETURNS FROM F-4 AND RF-4 AIRCRAFT
Roy A. Parker 13 May 1976 51 p
(AD-A027417; Rept-75/68S-17) Avail: NTIS HC A04/MF A01 CSCL 17/9

This report concerns the degraded identification friend or foe/selective identification feature (IFF/SIF) returns received from F-4 and RF-4 aircraft by radar facilities using the AN/UPX-6 interrogator set. The specific system investigated was an AN/MPN-13 mobile ground control approach facility. The primary cause of the degradation was that the alignment of the KY-532B/ASQ airborne transponders in the subject aircraft was not compatible with the interrogation pulses transmitted by the AN/UPX-6. Author (GRA)

N77-15242# Florida Univ., Gainesville. Dept. of Industrial and Systems Engineering.
EFFECT OF MIXED INSTRUMENTATION IN TRACKING TARGETS WITH MINIMAL ERROR
B. D. Sivazlian May 1976 61 p refs
(Grant DAHC04-75-G-0049; DA Proj. 2O0-61102-A-14D)
(AD-A026903; ARO-12848.3-M; RR-76-10) Avail: NTIS HC A04/MF A01 CSCL 17/9

Accurate statistical estimates of the Cartesian coordinates of a stationary target depend, in general, on such factors as target position, number and type of instruments, their location, their accuracy and their mix. For a mix of instruments, theoretical arguments are established to determine the optimal siting of the instruments which minimizes the geometric dilution of precision (GDOP), taken as the square root of the sum of the variances of the estimates in the three orthogonal directions. Direct measurements are assumed to be made in elevation, azimuth and range with errors independently and normally distributed. The method of maximum likelihood estimation is used to statistically characterize the random variable measuring the distance between estimated and true target position. To establish the most desirable siting of instruments and considering the elevation angle as decision variable, an optimization problem is formulated to minimize GDOP for various types of instrument mix. Author (GRA)

N77-15243# Kansas Univ. Center for Research, Inc., Lawrence. Remote Sensing Lab.
RADAR IMAGE SIMULATION PROJECT: DEVELOPMENT OF A GENERAL SIMULATION AND AN INTERACTIVE SIMULATION MODEL, AND SAMPLE RESULTS Contract Report, Dec. 1974 - Feb. 1976
J. C. Holtzman, V. H. Kaup, R. L. Martin, E. E. Komp, and V. S. Frost Feb. 1976 228 p refs
(Contract DAAK02-73-C-0106)
(AD-A027151; RSL-TR-234-13; ETL-0047) Avail: NTIS HC A11/MF A01 CSCL 17/9

This document reports the results of a radar image simulation study performed at the Remote Sensing Laboratory, the University of Kansas, Lawrence, Kansas. The work was sponsored by the U.S. Army Engineering Topographic Laboratories, Fort Belvoir, Virginia. The purpose of this study was to develop radar image simulation and feature extraction techniques. A general model for simulating radar imagery is developed. This model is applicable to both SLAR (Side-Looking Airborne Radar) and PPI (Plan Position Indicator) radar system image formats. It can produce simulations from both flat and mountainous terrain. The model requires as input a completely specified digital ground truth data base. The radar reflectivity data calculated for each image simulation can be determined from a variety of input data sources. The results presented in this document have all been produced using for input reflectivity data, empirical radar backscatter data from a large agricultural/soil moisture data bank available at the Remote Sensing Laboratory. Also reported is a technique for automating feature extraction, creation of data bases, and interactive radar simulation. A model is developed which incorporates an image analyst (human) in the decision process as the computer simulation program runs. Automatic pattern recognition software is used to pre-process the data base and the interpreter/simulator is given the flexibility to specify or alter previous specifications in real-time in synthesizing the radar image. Author (GRA)

N77-15244# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE APPLICATION OF LINEAR PREDICTION TO SEQUENTIAL CLASSIFICATION OF RADAR TARGET SIGNATURES
Charles W. Therrien 25 Mar. 1976 38 p refs
(Contract F19628-76-C-0002; DA Proj. 8X3-63304-D-215)
(AD-A026695; ESD-TR-76-73; TR-517) Avail: NTIS HC A03/MF A01 CSCL 17/9

A linear-predictive form of the quadratic classifier (the optimal decision rule for Gaussian random processes) is developed and applied to the discrimination and classification of radar target signatures. The classifier was devised to implement a sequential probability ratio test (SPRT); that is, consecutive radar returns are observed until the target can be classified with a prescribed probability of error. Because of the linear-predictive formulation, the computational and storage requirements for the classifier are related only to the number of returns necessary to predict the signature and not to the length of signature observed; a classifier with modest storage and computational requirements can be employed to classify signatures consisting of an arbitrarily large number of radar returns. The classifier is related to several results in mean-square filtering theory and has an interpretation in terms of the maximum entropy and maximum likelihood spectral estimates for the target signatures.
Author (GRA)

N77-15245# Naval Postgraduate School, Monterey, Calif.
SAMPLED ANALOG RECURSIVE COMB FILTERS AND THEIR APPLICATION TO MTI-RADAR M.S. Thesis
Lars Terje Saetre Dec. 1975 94 p refs
(AD-A027267) Avail: NTIS HC A05/MF A01 CSCL 17/9

The design of second order sampled analog filters using Z-transform techniques developed in digital theory was studied. A second order recursive CTD-filter was implemented and investigated. Deviation from theoretical frequency response was found to be partly due to frequency dependent circuitry. MTI-simulation was performed, and the ability of the CTD-filter to cancel clutter and pass Doppler frequencies was demonstrated. Unexplained glitches in the filter output were noted. GRA

N77-15246# Naval Research Lab., Washington, D.C.
DETECTION IMPROVEMENT IN MULTIPATH USING EVEN AND ODD SYMMETRIC ANTENNA PATTERNS Interim Report
B. H. Cantrell and B. L. Lewis May 1976 8 p ref
(NRL Proj. R02-97; RR0210541)
(AD-A027044; NRL-MR-3301) Avail: NTIS HC A02/MF A01 CSCL 17/9

A new technique for enhancing the detection of targets by radars in a multipath environment is described. The method relies on the fact that when two channels using odd and even symmetry antenna patterns are placed symmetrically between the target and its image, the signal from one channel peaks when the other one nulls. The results are quite good when the target and its image are close to a beamwidth apart. However, deterioration takes place in nearly a linear manner as the target and its image is brought together. Author (GRA)

N77-15247# Ohio State Univ., Columbus. ElectroScience Lab.
MEASUREMENT OF THE POWER HANDLING CAPABILITIES OF A BIPLANAR SLOT ARRAY Technical Report, Mar. 1973 - Dec. 1975
C. J. Larson Jun. 1976 14 p refs
(Contract F33615-73-C-1173; AF Proj. 7633)
(AD-A027500; ESL-3622-9; AFAL-TR-76-58) Avail: NTIS HC A02/MF A01 CSCL 17/9

The subject of this report is the measurement of the power handling capability of a biplanar metallic radome. The radome, which is a double layer of slot arrays, is simulated by placing a small piece of the radome in a waveguide and using the images t9 simulate an infinite array. The power handling capability is determined by raising the incident power in the waveguide until the piece of radome breaks down. The incident breakdown power can be simply related to the breakdown power density of the array in free space. Biplanar radome surfaces able to handle power densities in excess of 4 megawatt sq m are demonstrated. The knowledge of the breakdown power density of the radome will aid the Air Force in designing airborne radar systems.
Author (GRA)

N77-15248# Rome Air Development Center, Griffiss AFB, N.Y.
EFFECT OF MULTIPATH ON THE HEIGHT-FINDING CAPABILITIES OF A FIXED-REFLECTOR RADAR SYSTEM. PART 1: ANALYSIS
Ronald L. Fante, Peter R. Franchi, and Richard L. Taylor May 1976 33 p refs
(AF Proj. 6813)
(AD-A027300; RADC-TR-76-169-Pt-1) Avail: NTIS HC A03/MF A01 CSCL 17/9

Analytical expressions are derived for the radiation pattern of a fixed reflector antenna on which there are two or more field horns operated in a monopulse mode to obtain target altitude information. Results are obtained for the radiation pattern of an arbitrary reflector located at an arbitrary height above, the earth, and fed by horns which may be located at an arbitrary position.
GRA

N77-15249# Science Applications, Inc., Berkeley, Calif.
EVALUATION OF PRESENT INTERNAL ELECTROMAGNETIC PULSE INTERACTION TECHNOLOGY: DESCRIPTION OF NEEDED IMPROVEMENTS Final Report
F. M. Tesche, M. A. Morgan, and B. H. Fishbine Kirtland AFB, N. Mex. AFWL May 1976 58 p refs
(Contract F29601-75-C-0112; AF Proj. 1209)
(AD-A027184; AFWL-TR-75-288) Avail: NTIS HC A04/MF A01 CSCL 18/6

This report presents a description of the state of the art in the area of internal electromagnetic pulse (EMP) interaction technology. Improvements in the modeling methodology are suggested and a number of specific problems are described which will permit more accurate solutions to problems in this area.
Author (GRA)

N77-15250# Science Applications, Inc., Berkeley, Calif.
INTERNAL INTERACTION ANALYSIS. TOPOLOGICAL CONCEPTS AND NEEDED MODEL IMPROVEMENTS Final Report
F. M. Tesche, M. A. Morgan, B. H. Fishbine, and E. R. Parkinson Kirtland AFB, N. Mex. AFWL May 1976 35 p refs
(Contract F29601-75-C-0012; AF Proj. 1209)
(AD-A027047; AFWL-TR-75-282) Avail: NTIS HC A03/MF A01 CSCL 18/6

This report introduces and formalizes various topological concepts for defining internal interaction problems. A preliminary examination of presently-used internal interaction models is made, and indications of possible improvements are given. Finally, a brief discussion of possible statistical approaches to the internal interaction problem is presented. Author (GRA)

N77-15251# Technology Service Corp., Santa Monica, Calif.
SYNTHETIC APERTURE RADAR APPLICATIONS STUDY Final Technical Report, May 1975 - Jan. 1976
Michael R. OSullivan and J. W. Bell Griffiss AFB, N. Y. RADC Apr. 1976 121 p refs
(Contract F30602-75-C-0182; AF Proj. 3201)
(AD-A026969; TSC-PD-B482-1; RADC-TR-76-114) Avail: NTIS HC A06/MF A01 CSCL 17/9

The purpose of this effort was to study the feasibility and methods of extracting DRLMS data base parameters from SAR imagery. It was concluded that much of the required DRLMS data exists in SAR imagery which can be extracted using an interactive system. A set of procedures and a conceptual design of an interactive system were developed for use in the extraction process. The outstanding questions concern metric accuracy, the efficiency of the overall system, and the amount of feature information image interpreters can extract. Author (GRA)

N77-15252# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
A SUBOPTIMAL ESTIMATION ALGORITHM WITH PROBABILISTIC EDITING FOR FALSE MEASUREMENTS WITH APPLICATIONS TO TARGET TRACKING WITH WAKE PHENOMENA
Michael Athans, R. H. Whiting (Lincoln Lab., Lexington), and Michael Gruber (Lincoln Lab., Lexington) 1976 19 p refs

(Grant AF-AFOSR-2273-72; AF Proj. 9769)
(AD-A027696; AFOSR-76-0851TR) Avail: NTIS HC A02/MF A01 CSCL 17/9

The purpose of this paper is to describe a suboptimal techique called probabilistic edit, which can be used for state variable estimation in conjunction with Kalman filtering techniques when the underlying noisy measurement process can contain false measurements, i.e., measurements containing no information about the state variables are certain random periods of time. The basic probabilistic edit algorithm is modified to accomodate real-time considerations and is incorporated into a seven-state extended Kalman filter which: (1) tracks ballistic re-entry vehicles, and (2) estimates their ballistic coefficient. In estimation problems of this kind, the radar measurements of the re-entry vehicles position are corrupted due to contamination of the hard body return with that of the wake. Consequently, a degradation in the performance of the basic tuned extended Kalman filter occurs. Thus, measurements that appear (in a probabilistic sense) to be highly contaminated by wake are modeled as false measurements. The paper includes a discussion of the effect of wake, a description of the basic tracking algorithm, and modifications of the basic tracking algorithm to compensate for the wake corrupted measurements. Finally, the performance of three distinct algorithms: (1) unmodified ballistic tracking filter, (2) modified ballistic tracking filter using a chi-square test to reject bad measurements, and (3) modified ballistic tracking filter using the probabilistic edit algorithm, using actual data will be presented. GRA

N77-15253# Ohio State Univ., Columbus.
CURRENTS INDUCED ON METAL/DIELECTRIC STRUCTURES FOR TRANSVERSE MAGNETIC PLANE WAVE INCIDENCE Final Report
Yeongming Hwang and W. D. Burnside Apr. 1976 34 p refs
(Contract F29601-74-C-0010; AF Proj. 3763)
(AD-A026896; AFWL-TR-75-116) Avail: NTIS HC A03/MF A01 CSCL 20/3

The induced surface current density on a two-dimensional air foil type wing by a Transverse Magnetic wave is studied in this report. The reaction concept is employed to formulate an integral equation for the structure. The surface current density is expanded with subsectional bases. The dielectric body is modeled with polarization current which is then expanded in terms of subarea bases. By enforcing reaction tests with an array of electric test sources which are the same as the expansion bases (Galerkin's method), the moment method is employed to reduce the integral equation to a system of simultaneous linear equations. Inversion of the matrix equation yields the current distribution. GRA

N77-15254# Intelcom Rad Tech, San Diego, Calif.
CABLE RESPONSE SOLUTION TECHNIQUES FOR THE SYSTEM-GENERATED ELECTROMAGNETIC PULSE ENVIRONMENT. VOLUME 1: METHODOLOGY AND DEVELOPMENT OF A SYSTEM GENERATED ELECTROMAGNETIC PULSE CABLE CODE Final Report
Eric P. Wenaas and Roland E. Leadon Kirtland AFB, N. Mex. AFWL May 1976 92 p refs
(Contract F29601-74-C-0039; AF Proj. 4995)
(AD-A027595; INTEL-RT-8111-078-Vol-1; AFWL-TR-75-174-Vol-1) Avail: NTIS HC A05/MF A01 CSCL 20/14

Solution techniques for the System Generated Electromagnetic Pulse (SGEMP) excitation of single- and multiple-wire cables are explored, and a formalism for solving the cable problem is defined. Progress on the development of a computer code for predicting these currents is reported. Author (GRA)

N77-15255# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
COMPUTER IDENTIFICATION OF PHONEMES IN CONTINUOUS SPEECH M.S. Thesis
Ralph W. Neyman Jun. 1976 137 p refs
(AD-A026018; GE/EE/76-10) Avail: NTIS HC A07/MF A01 CSCL 17/2

An approach to computer identification of phoneme-sized sound elements in continuous speech is presented. Using a tape recorder as an input device, analog speech signals are digitized and fast Fourier transformed. The amplitudes of the transformed signals are combined in a logarithmic manner and the resulting 16 channels of data used as the input to a phoneme recognition scheme. A running crosscorrelation is performed with 47 stored phoneme prototypes. The locations of 'possible' phonemes are determined and one set of possible phonemes selected. The procedure was performed on three replicates of 45 isolated words and on three replicates of ten sentences. GRA

N77-15256# Army Communications-Electronics Engineering Installation Agency, Fort Huachuca, Ariz.
DIGITAL TRANSMISSION EVALUATION PROJECT AN/FRC 162 TEST Final Report, Jan. 1975 - Feb. 1975
Edward F. New 31 May 1976 61 p refs
(AD-A026025; CCC-CED-76-DTEP-011) Avail: NTIS HC A04/MF A01 CSCL 17/2

The Collins Radio AN/FRC 162 radio was tested in back-to-back configuration and actual link configuration for determination of transfer parameters and to develop standard test techniques. The radio operates at a baseband rate of 12.5526 Mb/s (192 voice channels) in a 14 MHz bandwidth in the 8 GHz band. BER vs RSL characteristics are displayed as the primary mode of equipment evaluation. Carrier-to-interference data, switching errors, and baseband repeater operation data are presented. Power spectra are displayed showing 99% power bandwidth points and mask for the FCC emission limitations. The BER vs RSL does not deviate greatly from theoretical limits. Spectra emissions would violate 14 MHz digital limitations, if required. Resistance to co-channel interference is better than interference by frequencies adjacent to f which causes poor BER performance at low C/I ratios. Results of O switching performance show general conformance to specifications. Baseband repeater operation yields a BER performance 10 dB worse than one-hop operation. Link bit error rate unavailability is quantified graphically. Author (GRA)

N77-15257# Army Electronics Command, Fort Monmouth, N.J. Avionics Lab.
LABORATORY TESTING TECHNIQUES FOR HIGH-NOISE ENVIRONMENT COMMUNICATIONS SYSTEMS
Arthur W. Lindberg and Mitchell S. Mayer 1976 15 p refs
(AD-A026062) Avail: NTIS HC A02/MF A01 CSCL 17/2

The Army is looking to improve the performance of the communications systems so as to effectively eliminate the transmission and penetration of the undesired noise environment to the aviator's ear. The authors have developed new laboratory testing techniques for communication systems that must operate in high-noise environments. GRA

N77-15258# Rome Air Development Center, Griffiss AFB, N.Y.
RADIO FREQUENCY INTERFERENCE MEASUREMENT SET AN/MRM-14
Thomas E. Baustert May 1976 124 p
(AF Proj. 1232)
(AD-A026074; RADC-TR-76-66) Avail: NTIS HC A05/MF A01 CSCL 14/2

The report describes the effort that went into the development of the AN/MRM-14 Radio Frequency Interference Measurement Set. The program consisted of three major tasks: the procurement of automatic and manually controlled receiving equipment, development of a high gain directional antenna package, and complete system integration. GRA

N77-15259# Honeywell, Inc., St. Petersburg, Fla. Aerospace Div.
TROPOSCATTER PERFORMANCE MONITORING AND FAULT ISOLATION Final Technical Report, 2 May 1973 - 24 Apr. 1974
Griffiss AFB, N. Y. RADC Apr. 1976 92 p
(Contract F30602-73-C-0278; AF Proj. 6523)
(AD-A026235; HC6-16-02T-2; RADC-TR-76-110) Avail: NTIS HC A05/MF A01 CSCL 17/2

Performance monitoring and fault isolation techniques for troposcatters radio links were devised and evaluated through on-the-air tests using the AN/MRC-98 Radio set. The AN/MRC-98 was modified to provide demultiplexing of a common 12 VF channel group from the basebands of each of the 4 diversity receivers as well as from the diversity-combined baseband. A

measurement sensitive to the performance of the radio equipment was simultaneously and continuously performed in the same channel of each of these groups. The relative values of these redundant measurements at any one time provides an indication of the relative performance of those sections of the radio which are common to the individual measurements. Investigation of a bit error rate monitoring approach and a link noise measurement analysis approach is described. Both measurement approaches are supplemented by received signal level data for correlation and fault isolation purposes. Recommendations for implementing a tropo performance monitoring subsystem are presented.
Author (GRA)

N77-15260# Naval Postgraduate School, Monterey, Calif.
THE NAVAL COMMUNICATIONS PROCESSING AND ROUTING SYSTEM: ANALYSIS OF AN AUTOMATED SYSTEM M.S. Thesis
Beth Marie Hintz Mar. 1976 78 p refs
(AD-A026323) Avail: NTIS HC A05/MF A01 CSCL 17/2

This thesis is designed to present a detailed description and analysis of the Naval Communications Processing and Routing System (NAVCOMPARS). Discussed are the objective and principle of the Naval Telecommunications Automation Program (NTAP), with emphasis placed on delineating the shore components, particularily NAVCOMPARS. The capabilities of NAVCOMPARS are identified by describing the patterns of message flow through the automated system. Also considered are the manpower and training characteristics and the projected link with the Information Exchange Subsystem (IXS). A model of the central processing unit is presented in order to highlight the sequence of procedures employed by an automated message processing system. The underlying intent of this thesis is to provide a compact document which could be used as introductory material to acquaint non-computer specialists with the characteristics, requirements and potential of the Naval communications Processing and Routing system.
Author (GRA)

N77-15261# Wisconsin Univ., Madison.
PRECISION ALIGNMENT PROCEDURE FOR TROPOSCATTER SYSTEMS Final Technical Report, Jul. 1974 - Dec. 1975
W. P. Birkemeier and A. E. Sill Griffiss AFB, N. Y. RADC May 1976 75 p refs
(Contract F30602-74-C-0276; AF Proj. 0171)
(AD-A026234; RADC-TR-76-156) Avail: NTIS HC A04/MF A01 CSCL 17/2

This report contains a detailed investigation of a new approach to accomplishing alignment of troposcatter communications antennas along the great circle path. The new approach is based upon examination of the received CW signal's Doppler spectrum shape and its relation to antenna pointing angle. The Doppler spectrum shape was examined through forming the cross-correlation function of the quadrature components of the received signal. Available experimental evidence suggests an alignment accuracy of + or - 1/8 deg in less than one hour is attainable.
Author (GRA)

N77-15262# Naval Postgraduate School, Monterey, Calif.
A DIGITAL AUTOMATIC FREQUENCY CONTROL DESIGN
Glenn Everette Ewing Mar. 1976 84 p refs
(AD-A026462) Avail: NTIS HC A05/MF A01 CSCL 17/2

The paper describes a digital automatic frequency control (AFC) system designed for use with almost any conventionally-tuned, high-frequency communications equipment. When connected to a high-quality equipment, such as an R-390 receiver, frequency accuracy and stability approaching that of frequency synthesizers can be obtained. The AFC system digitally counts the frequency of all frequency-determining oscillators in the controlled equipment, computes and displays the operating frequency to the nearest Hertz. When the AFC is engaged, any deviation of the computed operating frequency from the desired frequency causes an error correction voltage to be generated. Use of this system requires that the controlled equipment be modified for voltage trimming of the tuning oscillator. GRA

N77-15263# Ohio State Univ., Columbus. ElectroScience Lab.
THE BEHAVIOR OF A WIDEBAND POWER INVERSION ADAPTIVE ARRAY WITH PULSED DESIRED SIGNALS Final Technical Report, 1 Dec. 1974 - 31 Jan. 1976
I. K. Lao and R. T. Compton, Jr. May 1976 52 p refs
(Contract N00019-75-C-0179)
(AD-A026443; ESL-4063-4) Avail: NTIS HC A04/MF A01 CSCL 17/2

This report discusses the behavior of a power inversion adaptive array with wideband signals. A two-element power inversion array using a two-section tapped delay line behind each element is studied. The performance of the array with a pulsed desired signal and broadband (25% bandwidth) directional noise interference is determined.
Author (GRA)

N77-15264# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
COMPUTER ALGORITHMS FOR THE EXTRACTION AND APPLICATION OF STRESS CONTOURS FROM CONTINUOUS SPEECH SENTENCES
Douglas C. Sargent and K. S. Fu Dec. 1975 229 p refs
(Grant AF-AFOSR-2661-74; AF Proj. 9769)
(AD-A026416; TR-EE75-44; AFOSR-76-0691TR) Avail: NTIS HC A10/MF A01 CSCL 17/2

Past research in speech recognition has emphasized the need to apply prosodic feature information when making decisions at the phonetic and lexical levels. Of particular interest has been a means by which the stress contour of a continuous speech sentence could be obtained without first performing phonetic recognition. The availability of such stress information permitted: (1) More accurate vowel recognition by determining beforehand the reliability of a phoneme's formant structure, (2) Word boundary detection, and (3) A partial estimate of a passage's syntactic structure.
GRA

N77-15265# Signatron, Inc., Lexington, Mass.
STUDY OF OPTIMUM SIMULATION TECHNIQUES FOR THE DESIGN AND EVALUATION OF ANTI-JAM COMMUNICATION SYSTEMS Final Report, 1 Feb. 1974 - 30 Jun. 1975
Leonard Ehrman, Steen Parl, John N. Pierce, and Steven H. Richman Mar. 1976 289 p refs
(Contract F33615-74-C-4065; AF Proj. 1227)
(AD-A026472; SIG-A-167-F; AFAL-TR-75-186) Avail: NTIS HC A12/MF A01 CSCL 17/2

The Communication Systems Evaluation Laboratory (CSEL), located at the Air Force Avionics Laboratory, is a real-time satellite simulation facility. This report investigates the application of CSEL to the LES 8/9 and GPS satellite programs. In addition, a new analysis of the effects of soft and hard limiters on frequency-hopped signals is presented.
GRA

N77-15266# Speech Communications Research Lab., Inc., Santa Barbara, Calif.
INVERSE FILTER PARAMETERS FOR SPEAKER IDENTIFICATION Final Report, Apr. 1974 - Apr. 1975
Larry L. Pfeifer Jun. 1976 80 p refs
(Contract F30602-74-C-0248; AF Proj. 7055)
(AD-A026847; RADC-TR-76-171; FR-22) Avail: NTIS HC A04/MF A01 CSCL 17/2

The capability to perform text-independent speaker identification is desirable because in many practical situations the text of a speech sample being tested will not be the same as the the text from which information was initially gathered about the speaker. The method of comparing feature vectors from individual sound units, usually vowels, has been studied as one possible approach to the problem. This report deals with an evaluation of three different types of parameters which are obtainable from the inverse filter method of linear prediction, namely the inverse filter coefficients, reflection coefficients, and cepstral coefficients. Using 821 samples of the vowel epsilon (as in the word bed) from 16 speakers a series of speaker identification experiment was performed using a Euclidean distance measure and a weighted Euclidean distance measure. Results showed that independent of the kind of experiment, or the distance measure, the cepstral coefficients and reflection coefficients had similar error rates and the errors were consistently lower than with inverse filter coefficients. It also demonstrated that these low-dimensional coefficient vectors can classify speakers nearly as well as spectral vectors which have a larger number of vector elements. The cepstral coefficients are of particular interest

because they are linearly related to the log spectral domain and can be computed from the inverse filter coefficients through a recursive procedure which is computationally more efficient than the classical double FFT procedure. GRA

N77-15267# Rome Air Development Center, Griffiss AFB, N.Y.
OPTIMUM COHERENT IMAGING OF A LIMITED FIELD OF VIEW IN THE PRESENCE OF ANGULAR AND APERTURE NOISE
Giorgio V. Borgiotti May 1976 33 p refs
(AF Proj. 4600)
(AD-A027639; RADC-TR-76-129) Avail: NTIS HC A03/MF A01 CSCL 09/4

An optimal procedure is established for the reconstruction of the angular object distribution in a given field of view (FOV). The object is coherently illuminated and located in the far zone of the receiving aperture. The procedure is 'uniformly' optimal in the sense of minimizing the statistical rms difference between the object distribution, modeled as a random function of the angular coordinates and its reconstructed image, for each direction belonging to the FOV. The observable complex amplitude distribution of the field on the aperture is due in the general case not only to the incident field scattered by the object but also to background disturbance, or 'angular noise', randomly distributed inside and outside the FOV, and is affected by 'measurement noise', that is random errors introduced in measuring the aperture field. The reconstruction algorithm consists of summing a truncated series of special functions - prolate spheroidal for the linear case and their generalization for two dimensional apertures - weighted by appropriate coefficients. These coefficients depend upon the observed aperture field and upon the relative power densities associated with the object field and the various types of noise. The series is truncated to a number of terms ('effective degrees of freedom' of the image) determined through an information theoretical method: each term of the series, suitably ordered, provides an information gain less than the preceding one, and the information gain goes rapidly to zero. The relationship between information transfer and mean-squared error for each term in the image series is established. Numerical examples are discussed. Author (GRA)

N77-15268# Joint Tactical Communications Office, Fort Monmouth, N.J.
COST EFFECTIVENESS PROGRAM PLAN FOR JOINT TACTICAL COMMUNICATIONS. VOLUME 3: LIFE CYCLE COSTING. APPENDIX F: COMPUTER MODELS FOR LCC Final Report
May 1976 94 p
(AD-A027643; TTO-ORT-032-76A-V3-APF) Avail: NTIS HC A05/MF A01 CSCL 17/2

The appendix describes and documents Life Cycle Costing (LCC) computer models and presents sample life cycle cost calculations using the models. The automated models primarily concentrate on O and S costs; however, complete life cycle costs are computed using as inputs point estimates for R and D and equipment unit production costs. The basic TRI-TAC LCCM is presented with the program as written for a Hewlett-Packard HP-9821A and makes reference to the same model which has been programmed in FORTRAN IV for use on the Burrough's B5550 Time Sharing System. The User's Guide for the FORTRAN IV version is included and an expanded version of the LCCM program written for the HP-9821A is also provided. GRA

N77-15269# Harris Corp., Melbourne, Fla. Electronic Systems Div.
DIGITAL MODEM STUDY, PHASE 2 Final Report, 12 Sep. 1975 - 21 May 1976
J. England 7 Jul. 1976 285 p
(Contract DCA100-75-C-0037)
(AD-A027496) Avail: NTIS HC A13/MF A01 CSCL 17/2

Phase 2 of a two-phased program to demonstrate feasibility of using a completely digital implementation for a PSK modulator/demodulator (modem) with an integral error-correcting coder/Viterbi decoder (codec) is described. A demonstration unit was evaluated in the areas of reduced costs, improved performance and stability, reduced maintenance and alignment requirements, improved reliability, and flexibility to accommodate changing mission requirements. The data presented indicates that the technical design goals were met or exceeded, as evidenced by the results of extensive testing. Author (GRA)

N77-15270# Georgia Inst. of Tech., Atlanta. Electronics Technology Lab.
INTERACTIVE COMMUNICATION SYSTEMS MODELING STUDY Interim Technical Report, 12 Jun. - 12 Nov. 1975
Richard W. Moss, Joe L. Hammond, and Ernest E. Donaldson
Griffiss AFB, N. Y. RADC May 1976 139 p refs
(Contract F30602-75-C-0247)
(AD-A026409; RADC-TR-76-155) Avail: NTIS HC A07/MF A01 CSCL 17/2

This interim report deals with the initial activities under an effort to develop an interactive computer model for analysis and design of digital communications systems. In this report concepts are formulated and described for a model for Interactive Design and Analysis of Communication Systems (MIDACS). Methods of approach for concept formulation are described, examples of previous modeling approaches are presented, and characteristics of the MIDACS concept are documented. Various interactive approaches are shown along with general hardware and software requirements. The formulated interactive concept includes the computer, display devices, and other input/output devices. Mathematical modeling approaches are described including standard Monte Carlo techniques, deterministic methods, and analytical models. The recommended modeling structure includes a modified Monte Carlo technique to minimize computer time for certain communication system performance measures. A multi-level analysis structure is proposed which includes a hierachy for the physical model combined with a hierarchy of analysis levels which permits greatest computer use flexibility.
Author (GRA)

N77-15271# Electronics Engineering Group (1842nd), Richards-Gebaur AFB, Mo.
AN/FRC-162 DIGITAL RADIO CHARACTERIZATION Final Report
James R. Hammer Jun. 1976 51 p
(AD-A026469; EEG/EPEU-TR-76-8) Avail: NTIS HC A04/MF A01 CSCL 17/2

Two AN/FRC-162 radios were tested in a simplex back-to-back configuration to determine standards, alignment procedures, and operational parameters in accordance with Digital European Backbone (DEB) system requirements. The transmitter was FM modulated with a three-level partial response digital baseband signal at a rate of 12.5526 Mbps. Selected tests were conducted with and without pilot and orderwire signals to determine RF spectral bandwidth. Curves were run on the output of the AFCS Baseband Degradation Monitor as a function of RSL and BER. The transmit RF spectrum was evaluated in accordance with 99% bandwidth and FCC mask (Docket No. 19311) criteria to determine bandwidth characteristics. GRA

N77-15272# Culler/Harrison, Inc., Goleta, Calif.
NETWORK VOICE TRANSMISSION. SPEECH COMPRESSION RESEARCH AT CHI Quarterly Technical Report, Mar. - May 1976
Glen J. Culler and Michael McCammon Jul. 1976 23 p refs
(Contract DAHC15-73-C-0252; ARPA Order 2359)
(AD-A027668; CHI-QTR-202) Avail: NTIS HC A02/MF A01 CSCL 17/2

A programmatically controlled analog switch unit for multiplexing several participants using a single vocoder into a network voice conference is described. Two methods of using this unit to support variations in conference protocols are discussed. An investigation was made of a proposed variable frame rate transmission system for network voice communication. This LPC-II system was compared with the existing system and several other possible choices. The comparisons are based on listening tests for quality and measured transmission rates.
Author (GRA)

N77-15273# California Univ., Los Angeles. School of Engineering and Applied Science.
ON RELIABLE TOPOLOGICAL STRUCTURES FOR MESSAGE-SWITCHING COMMUNICATION NETWORKS
Izhak Rubin Mar. 1976 64 p refs

(Contract N00014-75-C-0609; Grant NSF ENG-75-03224)
(AD-A027150; UCLA-ENG-7623) Avail: NTIS HC A04/MF A01 CSCL 17/2

The synthesis of optimal reliable (invulnerable) topological structures for message-switching communication networks is considered. The connectivity of the underlying graphs is used as a measure of the network invulnerability. The maximal average message delay value is used as the network delay measure. Simultaneously with choosing the topological structure, optimal line capacities are assigned. Therefore, the performance measure of a given network structure is chosen to be given by its delay-capacity product function, incorporating the product of the prescribed network maximal delay value and the associated minimal overall line capacity value. A general routing discipline is incorporated to account for dynamic updating of fixed routing procedures, needed to accommodate terminal traffic flow fluctuations. GRA

N77-15274# Army Communications Command, Fort Huachuca, Ariz.

STANDARD ENGINEERING INSTALLATION PACKAGE. US ARMY AIRFIELD/HELIPORT AIR/GROUND COMMUNICATIONS

28 May 1976 394 p
(AD-A026913; ACC-SEIP-010-C-1) Avail: NTIS HC A17/MF A01 CSCL 17/2

The U.S. Army Communications-Electronics Engineering Installation Agency (USACEEIA) is responsible for engineering and installing Communications-Electronics (C-E) equipment for the upgrade of Air Traffic Control (ATC) and Navigational and Landing Aids (NAVAIDS) at existing U.S. Army Airfields and Heliports (AAF/AHP) worldwide. The purpose of this Standard Engineering Installation Package (SEIP) is to guide all activities in the selection, acquisition, and installation of air/ground communications equipment for AAF/AHP. GRA

N77-15275# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

A PRELIMINARY COST ANALYSIS OF THE COMMUNICATIONS PROCESSOR FOR THE F-15 JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM M.S. Thesis

William Francis Gaumer Sep. 1976 87 p refs
(AD-A027365; GSM/SM/76S-8) Avail: NTIS HC A05/MF A01 CSCL 17/2

Budget restraints over the past several years have caused the Department of Defense to take a closer look at the new systems that it requires. Emphasis has been placed on not just the initial cost but the entire life cycle of the system. The Air Force has initiated several studies and projects aimed at reducing the total cost of new aircraft avionic systems. This thesis presents a preliminary analysis of the costs involved in acquiring and supporting a communications processor for the F-15 Joint Tactical Information Distribution System terminal. The characteristics of a digital computer are examined from an historical management perspective as well as the engineering design considerations. Two designs are presented: one is based on the current F-15 central computer while the other is based on current microcomputer technology. The software development and hardware procurement costs are estimated for each design, and the cost impact of the designs on several logistic support costs is also discussed. An analysis of these costs indicates that the microcomputer design would be the least costly of the two designs. Lower hardware procurement costs coupled with lower maintenance costs make the microcomputer design a most attractive alternative for implementation into the F-15 JTIDS terminal. Author (GRA)

N77-15276# Ohio State Univ., Columbus. ElectroScience Lab.

SATELLITE ANTENNA PATTERN DISTORTION DUE TO GROUND PLANE EDGES Final Report, 1 Jul. 1974 - 30 Sep. 1975

Charles L. Moore, Jr. and Gary A. Thiele Oct. 1975 141 p refs
(Contract N00014-75-C-0313)
(AD-A026184; ESL-4091-2) Avail: NTIS HC A07/MF A01 CSCL 09/5

The Hybrid Technique, which combines the Method of Moments with the Geometrical Theory of Diffraction, is used to investigate the radiation patterns of a UHF satellite antenna at various locations on a 28 in. by 28 in. square ground plane. Due to the diffraction which takes place at the edges of the ground plane, the radiation patterns are quite sensitive to the location of the antenna. It is concluded that, for the type of radiation coverage desired, it is best that the antenna be located close to one edge of the ground plane. Author (GRA)

N77-15277# Rensselaer Polytechnic Inst., Troy, N.Y.

MICROWAVE ACOUSTICS IN LAYERED STRUCTURE Final Technical Report, 20 Oct. 1973 - 30 Nov. 1975

P. K. Das Griffiss AFB, N. Y. RADC Apr. 1976 237 p refs
(Contract F30602-74-C-0100; AF Proj. 5573)
(AD-A026185; RADC-TR-76-104) Avail: NTIS HC A11/MF A01 CSCL 09/5

The initial objective of this research project was the characterization of the excitation and propagation of elastic waves in layered structures and the evaluation of the use of these structures in devices related to the field of microwave signal processing. A new side-entry laser probe technique was developed to accurately map the Rayleigh wave and the layer waves. This non-perturbing optical method gave direct information about the elastic field anywhere in the waveguide structure, the coupling efficiency between Rayleigh waves and layered waves and the nature of the elastic evanescent fields in the bounding solids. The high elasto-optic diffraction efficiency achieved utilizing this technique was employed to fabricate an elasto-optic modulator and convolver for signal processing. Studies on three basic convolver structures were made, though the emphasis in this contract was fabrication of 10 prototypes with center frequency 110 MHz. After these prototypes were completed, two other prototype convolvers using Si on LiNbO3 were built for operation at 230 MHz, 50 MHz bandwidth and 17 micro sec interaction time. The convolvers were tested and found to have good performance. Two new uses of the convolver structure were also found. These applications are ambiguity function generation and phase comparator in a phase locked loop. GRA

N77-15278# Army Electronics Command, Fort Monmouth, N.J. Communications/Automatic Data Processing Lab.

PERFORMANCE OF A J-BAND AIR-TO-GROUND WIDEBAND DATA LINK

James E. Bartow Jun. 1976 15 p refs
(AD-A027191; ECOM-4420) Avail: NTIS HC A02/MF A01 CSCL 17/2

This report discusses the effects of adverse weather conditions on a long air to ground data link. It includes attenuation due to rain and the degradation of antenna patterns caused by water film absorption on a radome and antenna feeds, and concludes that the link discussed falls about 7 dB short of the required margin for 1% of the year. Author (GRA)

N77-15279# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.

SPEAKER RECOGNITION FROM AN UNKNOWN UTTERANCE AND SPEAKER-SPEECH INTERACTION

R. L. Kashyap Jan. 1976 30 p refs
(Grants AF-AFOSR-2661-74; NSF ENG-74-17586; AF Proj. 9769)
(AD-A027652; TR-EE76-4; AFOSR-76-0692TR) Avail: NTIS HC A03/MF A01 CSCL 05/7

The authors are interested in determining whether a given utterance comes from a member of a given speaker group or an imposter. If it is the former, they are interested in determining the identity of the speaker. The only knowledge available is a set of known utterances from the given group of speakers. The given utterance is manually divided into phonemes without necessarily ascertaining the identity of phonemes. Using statistical decision theory they develop various types of tests for speaker verification and identification using only one phoneme segment or the entire utterance. They consider related problems such as the methods of clustering speakers to aid speaker verification, the optimal choice of phonemes for speaker recognition. GRA

N77-15280# British Library Lending Div., Boston Spa (England).

FAX: A STUDY OF PRINCIPLES, PRACTICE AND PROSPECTS FOR FACSIMILE TRANSMISSION IN THE UK

R. Barrett and B. J. Farbrother Nov. 1975 47 p refs (BLL-BLRD-5257; ISBN-0-85350-136-X) Avail: British Library Lending Div., Boston Spa, Engl.: £2.50

The history of facsimile production is reviewed. A survey is presented of current and proposed developments in reproduction technology. The cost of facsimile production in libraries, post offices, and businesses in the United Kingdom is analyzed. The need for standardization of equipment is discussed. A.H.

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N77-15281 Rensselaer Polytechnic Inst., Troy, N.Y.
EFFECTS OF FABRICATION AND TEMPERATURE ON BARITT DIODE OSCILLATORS Ph.D. Thesis
Jitendra Narain 1976 105 p
Avail: Univ. Microfilms Order No. 76-27201

Silicon Schottky and diffused BARITT and related devices are fabricated; the performance of these devices is evaluated, and a large signal analysis is developed to explain observed performance as an oscillator. Diffused device performance is evaluated from 350 K to 77 K. The power output and efficiency improve as the temperature decreases from 350 K to 150 K due to decreased space-charge effects. At 77 K the performance deteriorates due to the current transport being almost completely controlled by space-charge limited current. Schottky device performance is evaluated from 374 K to 300 K, and is mainly controlled by the current-voltage relationship, which is dependent on concentration of holes at the valence band edge and the space-charge effects. Dissert. Abstr.

N77-15282 Missouri Univ., Rolla.
FAULT DETECTION IN COMBINATIONAL CIRCUITS USING A STATISTICAL APPROACH Ph.D. Thesis
William Edward Pierson 1976 103 p
Avail: Univ. Microfilms Order No. 76-26866

Deterministic approaches to fault detection in combinational networks require that a set of inputs be applied to a circuit suspected of being faulty and that the corresponding outputs be compared to those of the non-faulty circuit either by simultaneously applying the inputs to a non-faulty copy of the circuit or by storing the correct outputs of the circuit in some list. A proposal that statistical analysis of the outputs be used to detect the presence of faults, is presented. It is shown that if the set (or sets) of input probabilities are chosen judiciously, a fault in a combinational network will change the expected value of the means of the outputs significantly enough to determine that a fault has occurred. Criteria for selecting input probabilities, establishing testing procedures, and evaluating test results are discussed. Dissert. Abstr.

N77-15283 State Univ. of New York, Stony Brook.
NICKEL AND NICKEL BASED ALLOYS AS OXYGEN ELECTRODES FOR ALKALINE WATER ELECTROLYSIS: ELECTROCHEMICAL AND ELLIPSOMETRIC STUDIES Ph.D. Thesis
Wen-Tong Peter Lu 1976 250 p
Avail: Univ. Microfilms Order No. 76-28057

The major objectives of the present study are: (1) to obtain electrode kinetic parameters for hydrogen and oxygen evolution reactions as a function of temperature and to ascertain the efficiency gain at higher operating temperature for water electrolysis; (2) to investigate the kinetics of the OER on Ni-based alloys or intermetallic compounds and to elucidate effects of electronic structure of the alloys on their electrochemical behavior; and (3) to correlate the optical properties of oxide films formed on oxygen electrodes with their electrocatalytic activities for the OER. Most of the Ni-based alloys exhibit electrode kinetic parameters for the OER similar to those on Ni. The present study confirms that there is no dependence of electrocatalytic activities of the alloys on their electronic properties. However, effects of the electronic structure of the alloys on oxide formation are detectable on bare electrode surfaces. Dissert. Abstr.

N77-15284 Duke Univ., Durham, N.C.
A NEW METHOD FOR MEASURING THE COMPLEX PERMITTIVITY OF HIGHLY CONDUCTIVE DIELECTRIC MATERIALS AT MICROWAVE FREQUENCIES Ph.D. Thesis
George Dakermandji 1976 115 p
Avail: Univ. Microfilms Order No. 76-27962

A method was developed for measuring the complex permittivity (dielectric constant and conductivity) of very high loss dielectric materials: loss tangent greater than about 0.1 and conductivity around 1 mho per meter or greater. A brief discussion of the main methods is given with comments on their advantages and disadvantages. Dissert. Abstr.

N77-15285 Georgia Inst. of Tech., Atlanta.
A GENERAL APPROACH TO THE PLANNING OF A TRANSMISSION NETWORK Ph.D. Thesis
Athanasios Panayotis Meliopoulos 1976 226 p
Avail: Univ. Microfilms Order No. 76-29356

The problem of optimal expansion planning of an electric power transmission network over a finite planning interval is addressed. A procedure was developed which yields an expansion policy, optimal with respect to a flexible economic criterion, and which incorporates realistic network constraints. The problem is formulated as a discrete time deterministic optimal control problem. A control at a time t is defined as the transmission facilities to be put in service at this time. To be determined is an optimal sequence of controls which will provide an admissible transmission system at any time during the planning period. An admissible transmission system is defined in terms of operational constraints of network security and reliability. These constraints require the solution to the problem of power flow on the network. The flow of power is modeled with the Kirchhoff's network laws, simplified at some degree. Dissert. Abstr.

N77-15286 Michigan Univ., Ann Arbor.
ANALYSIS OF STRIPS AND STRIP DIODE MOUNTS IN WAVEGUIDE Ph.D. Thesis
Kai Chang 1976 212 p
Avail: Univ. Microfilms Order No. 76-27463

A theoretical determination with experimental confirmation was made for the susceptance of narrow conducting strips in the transverse plane of a rectangular waveguide. The study includes single or multiple strips, as capacitive or inductive elements. The approach was based on a variational form for the susceptance, together with determination of a suitable current distribution along the strip. Both the coupling and the relative current distribution between multiple strips were also found. The analysis had direct application in the design of compact filters, broadband tuning circuits, matching networks and multi-diode circuits. The two-port equivalent circuit of a narrow strip located axially in a rectangular waveguide was also determined by theoretical analysis, with experimental confirmation.
Dissert. Abstr.

N77-15287 Rensselaer Polytechnic Inst., Troy, N.Y.
LOW FREQUENCY DIELECTRIC CHARACTERISTICS OF IONIC CONDUCTING GLASSES Ph.D. Thesis
Chul Ho Kim 1976 206 p
Avail: Univ. Microfilms Order No. 76-27198

Electrical measurements were made with an ac capacitance bridge, and dc transit charge-discharge measurements were performed to support the results of the ac measurements. Experimental results thus obtained were discussed in terms of existing theories. A satisfactory explanation for the electrode polarization was obtained with the space charge mechanism. Utilizing this space charge mechanism, an investigation of the glass surface structure was possible. In particular, 25 mol % Na_2O-SiO_2 glass and soda-lime glass were studied in more detail, and infrared measurements to determine the water content of the surface of these glasses were made to support the analyses. In addition, preliminary experiments on electronic conducting glass

were conducted to see if the ionic and electronic conducting glasses behave similarly. Dissert. Abstr.

N77-15288*# Scientific Translation Service, Santa Barbara, Calif.
ELECTRICAL RESISTIVITY OF CARBON BLACK KAOLIN COMPOSITE SINTERED MATERIALS
E. Kato Jan. 1977 23 p refs Transl. into ENGLISH from Kogyo Kagaku Zasshi (Japan), vol. 69, no. 2, 1966 p 196-202
(Contract NASw-2791)
(NASA-TT-F-17337) Avail: NTIS HC A02/MF A01 CSCL 09A

The resistivity-temperature characteristic was examined for C black-kaolin composite resistors sintered at 800-4000 deg, in order to find a suitable condition for prepared resistors of small temperature coefficient. The parameter for the temperature dependence, difined as gamma = -log (P200/P20), where P200 and P20 are the resistivities at 200 and 20 deg, respectively, is lowest when the temperature of the sintering is approximately 1300 deg. Author

N77-15289*# Scientific Translation Service, Santa Barbara, Calif.
ELECTRICAL RESISTIVITY OF CARBON BLACK-KAOLIN COMPOSITE SINTERED MATERIALS, 3
E. Kato Jan. 1977 26 p refs Transl. into ENGLISH from Kogyo Kagaku Zasshi (Japan), vol. 68, no. 6, 1965 p 1038-1044
(Contract NASw-2791)
(NASA-TT-F-17339) Avail: NTIS HC A02/MF A01 CSCL 09A

Chemical and physical changes in a carbon black-kaolin composite during sintering and their effects on electrical resistivity were studied by using Korean Kaolin and pure carbon black as raw materials and sintering at 1000 - 1400 deg. Changes occurring at greater than 1200 deg are attributable to glass formation and chemical reactions between the 2 materials. Chemical reactions are divided into 2 steps. The reaction occurring at 1200-60 deg, where Fe_2O_3, present as one of the impurities in kaolin, is reduced to Fe by C, and the reaction at greater than 1300 deg, where part of the SiO_2 is reduced to SiC. A new relation was found between 1/c and log p at constant C content, where c is the bulk d. of C and p is the resistivity of the composite sintered materials. Author

N77-15290*# Scientific Translation Service, Santa Barbara, Calif.
ELECTRICAL RESISTIVITY OF CARBON BLACK-KAOLIN COMPOSITE SINTERED MATERIALS, 4
E. Kato Jan. 1977 28 p refs Transl. into ENGLISH from Kogyo Kagaku Zasshi (Japan), vol. 69, no. 2, 1966 p 188-195
(Contract NASw-2791)
(NASA-TT-F-17338) Avail: NTIS HC A03/MF A01 CSCL 09A

The electrical resistivity at temperatures 20 to 200 was examined on carbon black-kaolin composite resistors sintered at 800-1200, which was compared with the resistivities of powder mixtures of carbon black and glass or TiO_2. The dependence on the carbon bulk d., carbon, was similar in these two kinds of systems. The resistivity increases linearly with 1/C for 1/C is greater than 11, but changes more rapidly for larger value of 1/C. Its temperature coefficient is always negative, which increases with 1/C. A model consisting of resistors connected in parallel is given for the explanation of the observed results. Author

N77-15291*# Fairchild Imaging Systems, Syosset, N. Y.
SOLID STATE TELEVISION CAMERA (CCD-BURIED CHANNEL) Final Report
3 Dec. 1976 75 p
(Contract NAS9-14844)
(NASA-CR-151150; ED-AX-76) Avail: NTIS HC A04/MF A01 CSCL 09C

The development of an all solid state television camera, which uses a buried channel charge coupled device (CCD) as the image sensor, was undertaken. A 380 x 488 element CCD array is utilized to ensure compatibility with 525 line transmission and display monitor equipment. Specific camera design approaches selected for study and analysis included (a) optional clocking modes for either fast (1/60 second) or normal (1/30 second) frame readout, (b) techniques for the elimination or suppression of CCD blemish effects, and (c) automatic light control and video gain control (i.e., ALC and AGC) techniques to eliminate or minimize sensor overload due to bright objects in the scene. Preferred approaches were determined and integrated into a deliverable solid state TV camera which addressed the program requirements for a prototype qualifiable to space environment conditions. Author

N77-15292*# Kanner (Leo) Associates, Redwood City, Calif.
ELECTRICAL CONDUCTIVITY OF GLASS-CARBON
B. M. Barykin, E. G. Spiridonov, and A. S. Tarabanov Washington NASA Dec. 1976 9 p refs Transl. into ENGLISH from Khim. Tverdogo Topliva (USSR), v. 2, 1967 p 116-119
(Contract NASw-2790)
(NASA-TT-F-17347) Avail: NTIS HC A02/MF A01 CSCL 09C

The electrical condition of glassy C, prepared by carbonization of a 30:70 mixture of cellulose and a synthetic resin, was studied at 300-725 and 1,150-2,700 K. The glassy C was prepared at 1,000 K, and its apparent dimeter was 1.52 g/cu cm. A photomicrograph of the surface of the glassy C is shown. The dependence of the electrical resistance on temperature is given in graphs for the glassy C sample before and after annealing at 2,600 K, the curves being similar to those of pure semiconductors. The higher electrical resistance (0.48 and 0.09 vs. 0.28 and 0.18 ohm-cm at 325 and 725 C, respectively) and its linear temperature dependence in the annealed sample are attributed to formation of graphite crystalline nuclei in the previously homogeneous and amorphous glassy C. Author

N77-15293*# National Aeronautics and Space Administration, Washington, D.C.
METHOD FOR PRODUCING THIN SURFACE BARRIER DIODE Patent Application
Karl Reinitz, inventor (to NASA) (APL, Laurel, Md.) Filed 24 Nov. 1976 15 p Sponsored by NASA
(NASA-Case-HQN-10887-1; US-Patent-Appl-SN-744575) Avail: NTIS HC A02/MF A01 CSCL 09A

A method of fabricating a thin surface barrier diode is provided which utilizes a low resistivity starting substrate having a frying pan shape comprised of a generally circular body portion and an elongate handle portion. After a high resistivity epitaxial layer is grown in a slow, highly controlled manner, the substrate is mounted in an inert housing in which selected portions of the high resistivity silicon are etched away and the resultant device cleaned and dried. The housing preferably includes a mounting block containing recesses in which holders for the substrate and the etching electrode are mounted in such a manner as to bring the substrate and electrode into proper registry. The etched substrate is subsequently mounted in a support and treated to form a barrier diode detector, the handle being etched away as a final step. NASA

N77-15294# Sandia Corp., Albuquerque, N.Mex.
AUTOMATIC CIRCUIT ANALYSIS BASED ON MASK INFORMATION
B. T. Preas, B. W. Lindsay, and C. W. Gwyn 1976 9 p refs Presented at the 13th Design Automation Conf., Palo Alto, Calif., 27 Jun. 1976 Sponsored by ERDA
(SAND-75-6193; Conf-760609-2) Avail: NTIS HC A02/MF A01

The Circuit Mask Translator (CMAT) code has been developed which converts integrated circuit mask information into a circuit schematic. Logical operations, pattern recognition, and special functions are used to identify and interconnect diodes, transistors, capacitors, and resistances. The circuit topology provided by the translator is compatible with the input required for a circuit analysis program. ERA

N77-15295# Sandia Corp., Albuquerque, N.Mex.
DESIGN RULE CHECKING AND ANALYSIS OF 4 MASK DESIGN
B. W. Lindsay and B. T. Preas 1975 22 p refs Presented at 13th Design Automation Conf., Palto Alto, Calif., 27 Jun. 1976 Sponsored by ERDA
(SAND-75-6192; Conf-760609-7) Avail: NTIS HC A02/MF A01

A new mask analysis code for design rule checking is

described. The code provides a number of high-level (LOGMASC) commands which allow the designer complete freedom in performing almost any design rule check desired. From simple width or tolerance checks to sophisticated checks involving pattern recognition. One of the extremely important features of the sophisticated checks is the elimination of false design rule violations normally encountered when only simple checks are performed. Although the use of the LOGMASC code is described for a CMOS circuit, the code is completely general and can be used for design rule checking and analysis of mask information for any technology. ERA

N77-15296# California Univ., Livermore. Lawrence Livermore Lab.
HIGH POWER SEMICONDUCTOR SWITCHING IN THE NANOSECOND REGIME
O. S. Zucker, J. R. Long, V. L. Smith, D. J. Page, and J. S. Roberts Dec. 1975 8 p refs Presented at IEEE 6th Symp. on Engr. Problems of Fusion Res., San Diego, 17 Nov. 1975
(Contract W-7405-eng-48)
(UCRL-77563; Conf-751125-142) Avail: NTIS HC A02/MF A01

Light activated multilayered silicon semiconductor devices have been used to switch at megawatt power levels with nanosecond turnon time. Current rate of rise of 700 kA/microsecond at 10 kA, with 1 kV across the load, has been achieved. Recovery time of 1 millisec has been obtained. Applicability to fusion research needs is discussed. ERA

N77-15297# Bendix Corp., Kansas City, Mo.
MULTIPLE HYBRID MICROCIRCUIT PROCESSING Final Report
L. E. Schantz Jan. 1976 50 p refs
(Contract AT(29-1)-613)
(BDX-613-1383) Avail: NTIS HC A03/MF A01

Fabrication methods suitable for processing multiple hybrid microcircuits (HMCs) on 95 by 114 mm substrates through thin film metallization and photolithography are reported. Each fabrication method studied was based on its potential for multiple hybrid microcircuit processing. Thin film deposition parameters were analyzed in terms of thin film properties necessary to meet HMC electrical and component attachment requirements, and photolithography parameters were analyzed in terms of dimensional requirements on the circuit pattern. The objective of this effort was met, and the techniques developed are being used successfully in the production of multiple HMCs. ERA

N77-15298# Naval Electronics Lab. Center, San Diego, Calif.
DIPOLE BROADBAND VHF ANTENNA. LIGHTWEIGHT 30-76-MHz DIPOLE FUNCTIONS AS THE ELECTRICAL EQUIVALENT OF THE 400-LB AS-2231 Technical Report, 1 Jul. 1974 - 15 Jan. 1976
Eric A. Thowless 13 Apr. 1976 34 p
(NELC Proj. B605; XF21222033)
(AD-A027289; NELC-TD-472) Avail: NTIS HC A03/MF A01 CSCL 09/5

An antenna is developed for use aboard amphibious ships and at fixed unit command centers ashore. Electrical concept feasibility is demonstrated in laboratory tests. The 50-60-lb VHF broadband dipole antenna will function as the electrical equivalent of the 400-lb AS-2231 aboard ship, and, used ashore, will enable a significant reduction in number of VHF antennas required at command sites. The effort demonstrates that a universal VHF broadband antenna, capable of satisfying the diverse requirements of the Navy, the Marine Corps, and the Army, is not likely to be achieved. Author (GRA)

N77-15299# General Electric Co., Binghamton, N.Y. Aerospace Controls and Electrical Systems Dept.
THE 150 KVA SAMARIUM COBALT VSCF STARTER GENERATOR ELECTRICAL SYSTEM, PHASE 1 Final Report, 1 Jun. 1974 - 29 Mar. 1976
Lee J. Bailey, Lawrence W. Messenger, David L. Lafuze, and Charles F. Triebel Mar. 1976 227 p
(Contract F33615-74-C-2037; AF Proj. 3145)
(AD-A026518; ACS-1109; AFAPL-TR-76-8) Avail: NTIS HC A05/MF A01 CSCL 10/2

Development and construction of a solid rotor using rare earth samarium cobalt magnets for a 150 KVA Variable Speed Constant Frequency Starter/Generator electrical system is described. The system consists of the solid rotor 14-pole starter/generator which, in the generate mode, is driven at 12,000 to 21,000 RPM and a cycloconverter which converts the 9-phase variable frequency power from the generator to a high quality 3-phase, 400 Hz, 150 KVA power source. In the start mode, the cycloconverter converts 3-phase, 400 Hz power to a 9-phase variable frequency, variable voltage which is used to power the starter/generator as a synchronous motor. GRA

N77-15300# Army Electronics Command, Fort Monmouth, N.J. Communications/Automatic Data Processing Lab.
INSULATED SUBSURFACE HORIZONTAL WIRE
F. Schwering May 1976 21 p refs
(DA Proj. 1T1-61102-B-31A)
(AD-A027504; ECOM-4408) Avail: NTIS HC A02/MF A01 CSCL 09/5

The characteristic parameters of near-the-earth horizontal wire antennas depend significantly on the height at which these antennas are suspended above ground. The question may be asked: Does a similar dependence on distance from the earth's surface exist for antennas buried at shallow depths. By using a transmission line approach, it is shown that variations of the input parameters are caused primarily by the height- or depth-dependence of the capacitance per-unit-length of the antenna wire. (In the case of a buried antenna, the wire is assumed to be insulated from the ground by a thick coat of a low-loss dielectric). The inductance and resistance per unit-length, on the other hand, are approximately constant in the range of low heights above ground to shallow burial depths. It is furthermore concluded that the capacitance per-unit-length of a subsurface antenna is also nearly constant as long as the antenna remains at a sufficient distance from the earth's surface. Hence, little variation of the input parameters should be expected in the range of small burial depths. The rather rapid variation of these parameters will commence only when the antenna is at such shallow depths that its capacitance per-unit-length is significantly affected by the presence of the air-earth interface. This variation continues as the antenna is thought to be raised out of the ground and into the air half-space. Author (GRA)

N77-15301# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
EQUIVALENT CIRCUIT FOR SERIES CONNECTED GC23C NICKEL-CADMIUM CELLS Interim Technical Report, Apr. 1974 - Mar. 1976
David H. Fritts May 1976 31 p refs
(AF Proj. 3145)
(AD-A026171; AFAPL-TR-76-18) Avail: NTIS HC A03/MF A01 CSCL 10/3

An electrical equivalent circuit for nickel-cadmium batteries, using GC23C cells, is derived that has fixed, lumped parameter circuit elements and is scalable for series connected cells. Some of the individual circuit elements are investigated to determine if they can be related to physiochemical phenomena in the batteries. The results of this work show that equivalent circuits that are useful to the electrical engineer are feasible and that its elements are interpretable. Author (GRA)

N77-15302# General Electric Co., Schenectady, N.Y.
DESIGN, FABRICATION, AND EVALUATION OF AN ELECTRON BEAM ADDRESSABLE HIGH INFORMATION DENSITY MEMORY TUBE Interim Report, 1 Sep. 1975 - 31 Jan. 1976
C. Q. Lemmond, W. C. Hughes, C. G. Kirkpatrick, E. C. Buschmann, and H. W. Grup Jun. 1976 43 p refs
(Contract DAAB07-75-C-1312; DA Proj. 1S7-62705-AH-94D)
(AD-A026217; SRD-76-065; ECOM-75-1312-3; IR-3) Avail: NTIS HC A03/MF A01 CSCL 09/2

Electron Optical component improvements were made to simplify the tube construction and as first steps toward ruggedizing the tube. These modifications were thoroughly tested, and the results indicate extremely stable beam control as well as a design that can more easily be made rugged. Tests to verify tube operation capability at 10 megabit data rates were successfully completed. Storage target improvements continue. Author (GRA)

N77-15303# Illinois Univ., Urbana-Champaign. Coordinated Science Lab.

OPTIMAL NOR NETWORKS FOR SELF-DUAL FUNCTIONS OF FOUR VARIABLES

D. Reynolds and G. Metze May 1976 23 p refs

(Contract DAAB07-72-C-0259)

(AD-A027278; R-729; UILU-ENG-76-2217) Avail: NTIS HC A02/MF A01 CSCL 09/2

A complete catalog of optimal NOR realizations for all self-dual functions of four or fewer variables is presented, where optimality is achieved by first minimizing the number of gates required, then minimizing the number of gates inputs required, and finally, minimizing the number of logic levels required to realize the function. Complements of input variables are assumed to be unavailable. GRA

N77-15304# Lehigh Univ., Bethlehem, Pa. Dept. of Physics.

OPTICAL AND EPR STUDIES OF IRRADIATED SILICON DIOXIDE MATERIALS Final Prgress Report, 1 Jul. 1975 - 30 Jun. 1976

Colin E. Jones 15 Jul. 1976 40 p refs

(Contract N00014-67-A-0370-0009; NR Proj. 322-020)

(AD-A027443) Avail: NTIS HC A03/MF A01 CSCL 20/12

Optical absorption, luminescence, and electron spin resonance have been measured for crystalline and amorphous silicon dioxide materials. The luminescence data and its correlation with the optical absorption and spin resonance form basically new areas of research. For fast neutron irradiation the luminescence increases with irradiation, and a band tentatively identified with the oxygen vacancy correlates with the optical absorption and spin resonance for this defect. Above 10 to the 20th power neutrons/sq cm the luminescence, especially the oxygen vacancy luminescence, decreases, suggesting the formation of a large number of nonluminescent competing traps. Gamma irradiation has a much larger effect on amorphous silicon dioxide than on crystalline materials. The same effect seems to be present in gamma irradiated metal-oxide semiconductors up through 10 to the 7th power. GRA

N77-15305# Intelcom Rad Tech, San Diego, Calif.

PACKAGING EFFECTS ON SEMICONDUCTOR DEVICE RADIATION RESPONSE Final Phase Report, Jul. 1974 - Apr. 1975

Robert A. Berger and Joseph L. Azarewicz 15 May 1975 188 p refs

(Contract F04701-72-C-0322; AF Proj. 8125)

(AD-A026222; INTEL-RT-8025-724) Avail: NTIS HC A09/MF A01 CSCL 18/6

This report examines the effect of FXR-stimulated, re-emitted radiation from the packages of three planar-epitaxial transistors and two high-level NAND gate integrated circuits on the photocurrent response of the devices. Experimental measurements were made on the five devices in both low- and high-engery photon (FXR) environments. The experimental results are compared with a radiation transport analysis (including use of the SANDYL code) of the device package, materials, and proton energy spectrum. This work adds further verification to a procedure for extending simulation test data to a real photon environment. Author (GRA)

N77-15306# Army Materials and Mechanics Research Center, Watertown, Mass.

PIEZOELECTRIC POLYMER FILMS FOR APPLICATION IN MONITORING DEVICES

Richard J. Shuford, Anthony F. Wilde, John J. Ricca, and George R. Thomas 1976 14 p refs

(AD-A026155) Avail: NTIS HC A02/MF A01 CSCL 17/1

A piezoelectric material produces an electrical signal when subjected to a mechanical stress. Traditional examples of this effect have been demonstrated by certain ceramic materials and inorganic crystals. Recently, certain organic polymers, when properly treated (by both orientation and polarization), have exhibited this phenomenon. The purpose of our research in piezoelectric polymers is to prepare and characterize organic films for evaluation as transducer elements in devices, such as microphones, accelerometers, strain gages, and medical sensors. GRA

N77-15307# Defense Systems Management School, Fort Belvoir, Va.

TECHNOLOGICAL PROGRESS IN ELECTRONIC COMPONENTS: A LIFE CYCLE SUPPORT PROGRAM

Carroll Eugene Garrison May 1976 66 p refs

(DSMS Proj. PMC-76-1)

(AD-A026382) Avail: NTIS HC A04/MF A01 CSCL 15/5

Given the current rate of technological change in electronic components, repair parts support over the total life cycle of a weapons system or item of electronic equipment in the defense inventory is becoming increasingly difficult. The technological evolution of a selected group of components, including receiving vacuum tubes, transistors, integrated circuits and micoprocessors is briefly reviewed. Case histories of life cycle support problems are used to emphasize circumstances encountered when changes in technology result in either a discontinuance, or a reluctance to continue production. The significance of governmental dependence upon commercial production bases is indicated. Approaches to design and support planning which may reduce future problems caused by technological change are discussed and ranked. Specific examples of current application of these approaches are included. A relevant new DOD Directive, concerned with diminishing sources of supply and material shortages, is introduced. This Directive, in draft, is currently being staffed with DOD Components. This study should serve as a useful source of information to acquisition managers and others responsible for systems development and support planning. Author (GRA)

N77-15308# Optel, Inc., Princeton, N. J.

ELECTROCHROMIC DISPLAY DEVICE Semiannual Report, 1 Mar. - 31 Aug. 1975

S. K. Deb and H. Witzke Apr. 1976 46 p refs

(Contract DAAB07-75-C-1310; ARPA Order 2822)

(AD-A027052; ECOM-75-1310-1) Avail: NTIS HC A03/MF A01 CSCL 09/5

The work has been concentrated on the optimization of the fabrication process of known solid state electrochromic devices and on the evaluation of their performance characteristics. Significant progress has been made in the successful routine fabrication of an improved structure consisting of SnO2-WO3-MgF2-Au-MgF2. This structure appears to have superior electrochromic properties when compared to the corresponding devices such as SnO2-WO3-SiO-Au which have been studied earlier. Although the lack of reproducibility of the electro-optical characteristics among samples prepared under apparently identical conditions still remains a major enigma, considerable insight has been obtained on various parameters which affect the performance of solid state electrochromics. The solid state electrochromic devices that are being investigated consist of a multilayer thin film structure. Each of the constituent layers can critically affect the electro-optical characteristics, and, therefore, the major part of the work had to be directed toward the optimization of each layer with respect to parameters such as: substrate preparation, electrochromic material selection, methods of film preparation, control of deposition parameters such as rate of evaporation, substrate temperature, selection of suitable insulating material, development of a transparent counter electrode and the protection of the device against mechanical damage and chemical contamination. GRA

N77-15309# Harry Diamond Labs., Adelphi, Md.

ICEDIT: AN INTERACTIVE GRAPHICS EDITOR FOR INTEGRATED CIRCUIT MASKS

Steven J. Choy May 1976 60 p

(DA Proj. 1W6-62616-AH-77)

(AD-A027022; HDL-TM-76-8) Avail: NTIS HC A04/MF A01 CSCL 09/2

The ICEDIT system is an interactive graphic editor used to input, manipulate, and store integrated circuit masks. Its capabilities include graphic input, keyboard input, interactive graphic editing, and data output to teletype, printer, nine-track magnetic tape, or disc file on a PRIME 300 minicomputer in FORTRAN IV. GRAFHELP and GTS are used as the graphics support. The graphics terminal is the Imlac PDS-4 display system. The capabilities, operations, and software design of the system are discussed. GRA

N77-15310# Army Electronics Command, Fort Monmouth, N.J. Communications/Automatic Data Processing Lab.
REPLACEMENT OF RT-524/246 TRANSMITTER TUBES BY TRANSISTOR INSERTS Technical Report, Jan. 1974 - Sep. 1975
Dieter R. Lohrmann and Walter D. Patterson Jun. 1976 59 p (AD-A026872; ECOM-4419) Avail: NTIS HC A04/MF A01 CSCL 17/2

The RT-524 and RT-246 VHF vehicular radios are in the field in large numbers. These will have to be maintained for the next 10-20 years or longer. In order to assure maintainability, and also to increase the reliability of the radio, replacement of transmitter tubes by transistor inserts was explored. A model was successfully designed, constructed and tested. In addition to improved reliability, another advantage is that the noisy fan does not operate under normal conditions. Therefore, the position of the radio is not given away in a quiet environment. A further advantage is that a 100% transmit duty cycle is possible.
Author (GRA)

N77-15311# Army Electronics Technology and Devices Lab., Fort Monmouth, N.J.
MECHANISMS OF DIELECTRIC RESONANT OSCILLATORS FOR MICROWAVE AND MILLIMETER-WAVE INTEGRATED CIRCUITS
Harold Jacobs and M. M. Chrepta 1976 15 p refs
(AD-A026052) Avail: NTIS HC A02/MF A01 CSCL 09/5

In the area of microwave and millimeter-wave devices and circuits, conventional metal waveguide components such as guides, cavities, filters, attenuators, couplers, etc., have proven so costly that many potential applications are not feasible. For instance, if one wanted to use millimeter-wave components for terminal homing through clouds or inclement weather, the millimeter-wave propagation characteristics would be desirable; but, the cost of placing receivers on every shell or missile would be prohibitive. Similar conclusions have been reached concerning other applications such as unattended receivers for electronic warfare, low altitude radar, and secure communications. To overcome this cost barrier, several proposals have been made for millimeter-wave integrated circuits. GRA

N77-15312# Naval Civil Engineering Lab., Port Hueneme, Calif.
STRUCTURAL ANALYSIS OF FAILSAFE INSULATOR ASSEMBLIES: Q9A, Q9B AND Q7A Final Technical Note, Jul. 1974 - Jun. 1975
S. K. Takahashi and T. K. Lew Jun. 1976 72 p refs
(YF53534011)
(AD-A026251; CEL-TN-1442) Avail: NTIS HC A04/MF A01 CSCL 09/5

Three types of failsafe guy insulator assemblies of the OMEGA navigation station guyed tower were load-tested statically to about twice the actual operating working load (AOWL). The primary purpose of the tests was to determine the behavior of the insulator cluster when the centerpost insulator was removed from the pentapost configuration. The tests showed that all pentapost and quadrapost configurations tested were safe at twice the AOWL; however, the Q9a quadrapost insulator system seemed to be headed toward the instability range beyond this load. Computer solutions were obtained and compared well with the experimental data. Finite element solutions can be used with economy to obtain the stress concentration factors between the sheds of the insulator and to predict the load distribution in the failsafe guy insulator system. GRA

N77-15313# RCA Solid State Technology Center, Somerville, N.J.
HIGH RELIABILITY, LOW COST INTEGRATED CIRCUITS Quarterly Development Report No. 1, 3 Feb. - 3 May 1976
May 1976 35 p refs
(Contract N00039-76-C-0240; XF54586002)
(AD-A026342) Avail: NTIS HC A03/MF A01 CSCL 09/5

The photomasks required for the fabrication of parts were designed. Modifications to the standard design rules were made to eliminate potential reliability hazards, and critical-process-step evaluations initiated. Wafer fabrication was initiated on five of the integrated circuit types. Process techniques were developed to plate 1.0 mil-high gold bonding bumps to facilitate the automated assembly process. Investigation of the beam tape structure showed that unplated tape may be successfully bonded to gold bumps without compromising reliability. This represents a potential major cost reduction. Life-test circuits for three integrated circuit types were designed and ordered. GRA

N77-15314# Naval Electronics Lab. Center, San Diego, Calif.
EVALUATION OF INDUSTRIAL INTEGRATED CIRCUIT TECHNIQUES FOR APPLICATION TO MILITARY ELECTRONICS Test and Evaluation Report, Jul. 1974 - Jun. 1975
C. A. West and W. J. Dyer Apr. 1976 172 p refs
(ZF61512001; NELC Proj. Z269)
(AD-A026621; NELC/TR-1957) Avail: NTIS HC A08/MF A01 CSCL 09/5

An investigation was made to determine available alternatives to MIL-SPEC integrated circuits and to determine whether industrial fabrication and test procedures could be used to evaluate components that could be used in the Fleet without degrading performance. It was concluded that commercial ICs should be capable of reliable operation in selected military systems under known or controlled conditions; that present TTL technology is more mature than CMOS technology; that introduction of industrially screened ICs into the Fleet can be accomplished through modification of existing specifications; that MIL-SPEC ICs are not readily available; and large-quantity procurement of industrially screened ICs results in increased reliability and lower costs. GRA

N77-15315# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
MANUFACTURING METHODS AND TECHNOLOGY PROGRAM FOR BEAM LEAD SEALED JUNCTION SEMICONDUCTOR DEVICES Quarterly Progress Report, 21 Nov. 1975 - 21 Feb. 1976
Dale Buhanan Feb. 1976 47 p
(Contract DAAB07-75-C-0033)
(AD-A026749; APR-3) Avail: NTIS HC A03/MF A01 CSCL 09/5

The object of the study is to refine the processes required to fabricate beam-lead sealed junction devices in production quantities by manufacturing methods. Considerable progress was made during the third quarter of the program. A number of different types of discretes and integrated circuits were delivered. Some of the past problems have been resolved, but the real challenge is still the discretes with their differing processing profiles. This report reviews the activities along with the present status of most of the devices. The tri-metallization process is reviewed in detail. GRA

N77-15316# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
APPLIED SUPERCONDUCTIVITY: AMPLIFIERS AND MICROCOMPOSITE WIRE
Arthur Davidson Jan. 1976 247 p refs
(Contract N00014-76-C-0032; Grant DAHC15-73-G-1616; NSF DMR-72-03020; NSF GH-34133; NR Proj. 318-003)
(AD-A026833; TR-12) Avail: NTIS HC A11/MF A01 CSCL 09/5

The report is in two parts. Part I is concerned with superconductive devices employed as amplifiers with particular emphasis on SQUID's. Part II is a study of superconductive microcomposite wires that have potential applications in industry. The wires are a microcomposite of Cu, Nb, and Sn, made by Tsuei's process. GRA

N77-15317# Microwave Associates, Inc., Burlington, Mass.
PRODUCTION ENGINEERING MEASURE FOR LOW NOISE SOLID STATE OSCILLATOR Interim Progress Report, 19 Nov. 1973 - 25 Aug. 1975
John C. Collinet and Lester C. Nelson Sep. 1975 97 p
(Contract DAAB05-72-C-5861)
(AD-A026909; ECOM-5861-I) Avail: NTIS HC A05/MF A01 CSCL 09/5

The initial program objectives have been expanded to include the production engineering for gallium arsenide, Gunn diode, low noise solid state oscillators at Ku-band and X-band frequencies. As a result of the evaluation of delivered engineering samples, two new Electronics Command Technical Requirements (ECTR)

have been generated which supersede the initial single ECTR. Typical engineering sample data are presented on the two units. A detailed analysis of the Load Pulling Effects on Oscillators was generated. A summary of the IMPATT diode work is given. A description of the manufacturing aspects of the oscillators is presented. A new milestone schedule was agreed to for the First Article and Pilot Production Phases of the Program. The First Article phase of the program was initiated. Author (GRA)

N77-15318# Harris Corp., Rochester, N. Y. Communications Div.

TRANSISTORIZED RF POWER AMPLIFIER AND DRIVER FOR RECEIVER TRANSMITTERS RT-246/VRC AND RT-524/VRC Final Report, Sep. 1975 - Mar. 1976

B. Williams Jun. 1976 45 p

(Contract DAAB07-75-C-0146)

(AD-A026921; ECOM-75-0146-F) Avail: NTIS HC A03/MF A01 CSCL 09/5

This final report describes development work on the transistorized RF Power Amplifier Tuner/Driver Assembly for the Receiver Transmitter RT-524 and RT-246. During this reporting period, a prototype power amplifier and tuner/driver were constructed and bench tested. Three deliverable units were then constructed and tested. Complete performance and temperature tests were run before the three deliverable units were shipped to ECOM for further evaluation. Data covering the major operating parameters measured during testing are presented in this report. Author (GRA)

N77-15319# Martin Marietta Aerospace, Orlando, Fla.

PRINTED WIRING BOARD PRODUCTION ASSEMBLY COST GUIDELINES MANUAL Final Report, 26 Mar. 1975 - 25 Mar. 1976

Sol C. Osborne, Wendell R. Hutchinson, and Frederick E. Tartaglia Mar. 1976 270 p

(Contract DAAB07-75-C-0029)

(AD-A026944; OR-13826-2) Avail: NTIS HC A09/MF A01 CSCL 09/5

Cost forms, cost/manhour data tables and equipment payoff breakeven cost models provided for the user of this manual a direct approach of selecting the lowest cost PWB component assembly method. The comparisons required for solving assembly problems are given on state-of-the-art manual and automatic assembly methods. Formulated assembly and cost guidelines are provided for processes and equipment described for a variety of manual and automatic assembly methods. Author (GRA)

N77-15320# Naval Research Lab., Washington, D.C.

IMPEDANCE-MATCH AND ELEMENT-PATTERN CONSTRAINTS FOR FINITE ARRAYS Interim Report

Walter K. Kahn Jun. 1976 36 p refs

(NRL Proj. R02-29; WF12141601)

(AD-A027038; NRL-8002) Avail: NTIS HC A03/MF A01 CSCL 09/5

It is shown how an N-element antenna array may in principle be impedance matched by means of a specially designed interconnecting feed network to N real generators (for arbitrary excitation of these generators). The resulting element patterns for a single excited element (a single generator) in the terminated-array environment are then calculated. It is shown that for closely spaced regular arrays a condition of partial match, as contrasted with perfect match for all excitations, is the more appropriate design objective. The theory is illustrated through application to a uniform array of line sources. Element patterns obtained with an appropriately matched finite array are compared with those from the corresponding matched infinite-array model, the latter patterns having been obtained previously by an independent technique. The range of finite-array parameters to which the infinite-array model approximately applies is discussed. Author (GRA)

N77-15321# Naval Postgraduate School, Monterey, Calif.

CHARGE-COUPLED DEVICES FOR ANALOG SIGNAL PROCESSING: A CIRCUIT STUDY M.S. Thesis

Maxwell Douglas Biddle, Jr. Mar. 1976 92 p refs

(AD-A026378) Avail: NTIS HC A05/MF A01 CSCL 09/2

The operation of a two-phase charge-coupled shift register is discussed and analyzed. A parametric study for simultaneous operation with more than one input signal is presented. The output circuit is analyzed for its contribution to non-linearity. An analog signal processing linear model of the charge-coupled device is proposed. Author (GRA)

N77-15322# Los Alamos Scientific Lab., N.Mex.

DEVELOPMENT OF Nb3Ge CONDUCTORS FOR POWER TRANSMISSION APPLICATIONS Final Report

W. E. Keller, R. D. Taylor, M. P. Maley, and L. R. Newkirk Jul. 1976 73 p refs Sponsored by Elec. Power Res. Inst.

(PB-257565/2; EPRI-TD-200) Avail: NTIS HC A04/MF A01 CSCL 09A

Successful attempts are reviewed for producing coatings of Nb3Ge as thick as 70 micrometers deposited on Nb tubes 0.64 cm in diameter and 23 cm long, carrying a current density of 4,200,000 A/sq cm. Details of producing the samples by the chemical vapor deposition method are described. The effects of variation or process parameters to optimize the superconducting properties of the material are given, along with descriptions of diagnostic techniques used to characterize and correlate these properties. Initial attempts to produce longer lengths of conductor are also described. GRA

N77-15323# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.

MODELING TECHNOLOGY FOR BUNDLED POWER TRANSMISSION LINES Final Report

K. G. McConnell Aug. 1976 132 p refs Sponsored by Elec. Power Res. Inst.

(PB-257531/4; EPRI-TD-232) Avail: NTIS HC A07/MF A01 CSCL 09A

Twisting of the bundled phases is investigated to determine support rotations that would minimize the aerodynamic interactions of conductors within the bundle. The mechanical properties of the model conductor materials were measured, along with like properties of commonly used conductors. The test methods used in these measurements are described. GRA

N77-15324# BDM Corp., Albuquerque, N.Mex.

EVALUATION OF UNDERGROUND FAULT LOCATION TECHNIQUES Final Report

R. W. Deltenre, J. J. Schwarz, and H. J. Wagnon Apr. 1976 152 p refs Sponsored by Elec. Power Res. Inst.

(PB-257566/0; EPRI-TD-153) Avail: NTIS HC A08/MF A01 CSCL 09A

Available techniques for locating cable faults are discussed. An optimum technique is proposed, and a first order system is designed encompassing the best features of all techniques. A distribution fault location system (DFLS) and a transmission fault location system (TFLS) are recommended. Improvements incorporate modular design, automation, and reduction of operator experience factor for efficient operation. GRA

N77-15325# Battelle Pacific Northwest Labs., Richland, Wash.

DEVELOPMENT OF AN EVAPORATION-COOLED UNDERGROUND TRANSMISSION SYSTEM Final Report

J. G. DeSteese, D. J. Braun, L. L. Burger, and M. A. McKinnon Aug. 1976 260 p refs Sponsored in part by Elec. Power Res. Inst.

(Contract E(49-18)-2126)

(PB-257672/6; EPRI-TD-229) Avail: NTIS HC A12/MF A01 CSCL 09A

The development potential of the separate phase evaporation cooling concept for underground cables was studied by addressing crucial issues associated with coolant chemical stability, coolant distribution techniques, and system economics. GRA

N77-15326# Argonne National Lab., Ill.

SUPERCONDUCTING RECTIFIER DEVELOPMENT Final Report

K. E. Gray, R. P. Huebener, W. K. Chen, and D. E. Fowler Aug. 1976 84 p refs Sponsored by ERDA and Electric Power Res. Inst.

(PB-257533/0; EPRI-TD-245) Avail: NTIS HC A05/MF A01 CSCL 09A

The evaluation of superconductors for rectifiers of large scale electrical power is reported. The results of considerations of economics and technical feasibility of a full scale prototype rectifier

have clearly shown the impracticability of such a device operating at 60 Hz. The preliminary results are included. It should be emphatically stated that the superconducting switch, although impractical for 60 Hz rectification, appears to be well suited to lower frequency switching applications like fault current limiters, and these possibilities are described briefly. GRA

N77-15327# Habirshaw Cable and Wire Corp., Yonkers, N. Y.
INVESTIGATION OF MECHANISM OF BREAKDOWN IN XLPE CABLES Final Report
A. L. McKean, H. C. Doepken, K. Tsuji, and A. Zidon Jul. 1976 93 p refs Sponsored in part by Electric Power Res. Inst.
(Contract E(49-18)-1422)
(PB-257670/0; EPRI-TD-138) Avail: NTIS HC A05/MF A01 CSCL 09A

The research program explores the basic hypothesis that microporosity plays a significant role in the mechanism of breakdown of XLPE cable. The potential improvement achieved by impregnating the microporous regions of the cable core with a neutral liquid is evaluated, with relation to ac voltage life and impulse strength. The effect at higher frequency is also demonstrated. A similar test program is pursued on model cables, designed to explore the effects of gas pressure and gas type on breakdown and life, since it is reasonable to expect that only the microporous regions of the insulation should be sensitive to the gas pressure environment. GRA

N77-15328# American National Standards Inst., Washington, D. C.
SWITCHING TESTS OF SEPARABLE INSULATED CONNECTORS Final Report
Apr. 1976 45 p Sponsored by EPRI
(PB-257530/6; EPRI-TD-204) Avail: NTIS HC A03/AF A01 CSCL 09A

Changes to ANSI C119.2 are evaluated prior to approval of revisions as expressed by a Reliability Working Group drafting the proposed revision for the ANSI Subcommittee on Separable Insulated Connectors. After testing connectors of three manufacturers in three separate laboratories, the data were evaluated. The conclusion reached was primarily that no further revision of the test sections of ANSI C119.2, as revised, was necessary. GRA

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

N77-15329 Minnesota Univ., Minneapolis.
LAMINAR TUBE FLOW WITH A THERMOSETTING URETHANE POLYMERIZATION Ph.D. Thesis
Stephen David Lipshitz 1976 149 p
Avail: Univ. Microfilms Order No. 76-27813

The feasibility of mathematically modeling thermoset flow through a tube was studied. A two-component, thermosetting polyurethane system, comprised of a 1,6 hexamethylene diisocyanate oligomer and a three functional eta-caprolactone based triol, was used. When flow rate was held constant, the pressure was observed to rise continuously. The initially rapid rise reduced to an exponential rise after three to five minutes. When pressure reached 690 kN/sq m (100 psi), the low viscosity material was flushed from the reactor by dispensing only the triol component. Sectioning the reactors revealed a gelled layer deposited on the walls and a polymer free central core. A mathematical model was formulated in terms of the equations of conservation of mass, energy and momentum. Several simplifying assumptions were made. The resulting partial differential equations were solved numerically, using explicit, finite difference methods. Dissert. Abstr.

N77-15330 Duke Univ., Durham, N.C.
COMBINED NATURAL AND FORCED THERMAL CONVECTION IN A ROTATING SPHERICAL ANNULUS Ph.D. Thesis
Rodney Wayne Douglass 1976 283 p
Avail: Univ. Microfilms Order No. 76-27966

The analytical solution for the steady flow of a Newtonian fluid in the annulus formed by two concentric, coaxially rotating spheres is discussed. The spheres are each at a uniform, but different, temperature and rotate at independent constant rates. A uniform radial gravitational field is considered, and density variations are modeled by the Boussinesq approximation. Two solution methods are used to solve the coupled Navier-Stokes and energy equations. The first is a regular perturbation method which expands the dependent variables in a power series in the Reynolds number. This method gives results valid for small Reynolds numbers, unit order Prandtl numbers, and Grashof numbers of order sq Re. The second solution method is Kantorovich's extension of Galerkin's method for solving partial differential equations. Results from this method provide valid solutions for large parameter values. Dissert. Abstr.

N77-15331 Tufts Univ., Medford, Mass.
STABILITY OF A VISCOUS FLOW BETWEEN ROTATING COAXIAL CYLINDERS. PART 1: A NUMERICAL STUDY OF INSTABILITY OF FLOW BETWEEN ROTATING CYLINDERS. PART 2: HYDRODYNAMIC INSTABILITY OF A VISCOUS FLOW BETWEEN ROTATING COAXIAL CYLINDERS WITH MAIN AXIAL FLOW FULLY DEVELOPED Ph.D. Thesis
Kyung-Cho Chung 1976 126 p
Avail: Univ. Microfilms Order No. 76-27171

An efficient numerical method is developed to predict the conditions for instability in a viscous fluid contained between rotating coaxial cylinders of arbitrary radius ratio (0.1-0.95). Explicit finite difference approximations are used to solve the perturbed Navier-Stokes equations which are in linear form. Computational procedure as well as boundary conditions are described, and results are reported in terms of the critical Taylor number and corresponding wave number. Cases in which the cylinders are rotating in the same direction as well as in opposite directions are analyzed. The results are compared with other analytical solutions. Streamline distributions are presented at the critical state for several cases examined. The results indicate regions of time dependent modes in the secondary flow for cases of counterrotating cylinders. Dissert. Abstr.

N77-15332 Georgia Inst. of Tech., Atlanta.
WAVE PROPAGATION THROUGH FLOWING GAS-LIQUID MIXTURES IN LONG PIPELINES Ph.D. Thesis
Mahadevan Padmanabhan 1976 232 p
Avail: Univ. Microfilms Order No. 76-28890

The propagation of finite pressure waves through air water mixtures was investigated both experimentally and analytically. Two different experimental apparatuses were used, one consisting of a 61.5 ft long lucite pipe of 1 inch diameter and the other a 334 ft long coiled copper tubing of 0.5 inch diameter. Transient pressure records were obtained for a simple case of rapid closure of a valve at the downstream end of the pipe. Experiments covering bubbly flow and slug flow regimes were conducted for air water mixtures for which the volumetric quality beta varied from 0.005 to 0.18. The steepening phenomenon of compression waves, shock wave formation, and speed of propagation and structure of shock waves was studied in detail. One dimensional conservation equations for unsteady two phase flow were derived using both homogeneous and separated flow concepts. Dissert. Abstr.

N77-15333 Minnesota Univ., Minneapolis.
HEAT TRANSFER IN A PIPE DOWNSTREAM OF A TEE Ph.D. Thesis
David Allen Wesley 1976 116 p
Avail: Univ. Microfilms Order No. 76-27843

An experimental investigation was performed to determine the local heat transfer coefficients in a tube downstream of a Tee. Air was supplied to the center port of a Tee by a long, unheated hydrodynamic development tube. The two end ports of the Tee served as exits, and a uniformly heated and instrumented

tube was attached to each exit port. The degree to which the flow was split between the two heated tubes (flow split number) was one of the independent variables. One of the heated tubes served as the primary test section for the heat transfer measurements, while the other heated tube (secondary test section) served only as a flow exit tube. Dissert. Abstr.

N77-15334 Missouri Univ., Rolla.
DYNAMICS OF A PARTIALLY-FILLED CYLINDER Ph.D. Thesis
Don Ross Tichenor 1976 83 p
Avail: Univ. Microfilms Order No. 76-26872

A series of three problems involving the motion of partially full, thin-walled, circular cylinders which roll without slipping on plane surfaces was treated analytically. The first problem was concerned with the behavior of a thin-walled circular cylinder which contains a small cylindrical object and rolls on an inclined plane. The complex motion exhibited by the hollow cylinder was analyzed and compared with the motion of an empty thin-walled cylinder. Also, the motion of the internal cylinder was studied. The internal cylinder was called an oscillator because its motion was oscillatory and, under certain conditions, periodic. The effect of oscillator to cylinder mass ratio on the motion characteristics of the system was examined. Dissert. Abstr.

N77-15335 Michigan Univ., Ann Arbor.
THE RIEMANN PROBLEM IN GAS DYNAMICS Ph.D. Thesis
Randolph Gordon Smith 1976 124 p
Avail: Univ. Microfilms Order No. 76-27594

The Riemann Problem (R.P.) for the 3 x 3 system of gas dynamics equations in a single space variable is considered. It is assumed that the specific internal energy e = e(v,s) (s = specific entropy, v = specific volume) satisfies the usual hypotheses, p sub v is less than 0, p sub vv is greater than 0, p sub s is greater than 0, (p = minus e sub v = pressure). Some reasonable hypotheses about the asymptotic behavior of e are also assumed. Functions e satisfying these hypotheses are termed energy functions. Two theorems are presented to show that the Riemann problem has a unique solution for any initial data. Nonuniqueness persists under small perturbations of the initial data. In all solutions considered, the shocks satisify the entrophy condition and the lax shock conditions. Dissert. Abstr.

N77-15336 Michigan Univ., Ann Arbor.
SYMMETRY BREAKING IN FLUID DYNAMICS: LIE GROUP REDUCIBLE MOTIONS FOR REAL FLUIDS Ph.D. Thesis
Darryl Dallas Holm 1976 232 p
Avail: Univ. Microfilms Order No. 76-27494

The physics of fluids is based on certain kinematical invariance principles, which refer to coordinate systems, dimensions, and Galilean reference frames. Other, thermodynamic, symmetry principles are introduced by the material description. The interplay between these two kinds of invariance principles was used to solve for classes of one-dimensional non-steady isentropic motions of a fluid whose equation of state was of Mie-Gruneisen type. Also, the change in profile and attenuation of weak shock waves in a dissipative medium was studied at the level of Burgers' approximation from the viewpoint of its underlying symmetry structure. The mathematical method of approach was based on the theory of infinitesimal Lie groups. Fluid motions were characterized according to inequivalent subgroups of the full invariance group of the flow description, and exact group reducible solutions were presented. Dissert. Abstr.

N77-15337 Maryland Univ., College Park.
THE STRUCTURE OF CODIMENSION ONE FLOWS Ph.D. Thesis
Dennis Francis DeRiggi 1976 207 p
Avail: Univ. Microfilms Order No. 76-27375

A codimension one flow is a transformation group (X,R(n-1),pi) where X is a compact n-dimensional topological manifold without boundary, R(n-1) is real Euclidean space of dimensions n-1, and pi is a flow map. It is known that if x is any point in x with discrete isotropy group, then x is contained in a transversal set (a section of the flow. It is shown that these sections can be chosen to be homeomorphic to the unit interval. Furthermore, if X contains a transversal set C which is homeomorphic to the unit circle, S(1), such that C times R(n-1) is a regular covering space of X (with covering projection pi), then pi sub 1(X) is a free Abelian group on finitely many generators whenever (x,R(n-1),pi) is minimal and isotropy free. Dissert. Abstr.

N77-15338 Minnesota Univ., Minneapolis.
STATISTICAL MECHANICS OF TWO-DIMENSIONAL VORTICES IN A BOUNDED CONTAINER Ph.D. Thesis
Yves Bernard Pointin 1976 181 p
Avail: Univ. Microfilms Order No. 76-27921

The equilibrium statistical properties of a system consisting of a large number of two-dimensional vortices of arbitrary sign, evolving in an arbitrary domain closed by a bounded curve, are investigated under the fundamental assumptions of the equi-probability of any state compatible with a given value of the energy. The Salzberg and Prager equation of state is proved to be also valid in this general case. An expansion in inverse powers of the density closes the hierarchy of equations deduced from the fundamental assumption. The resulting nonlinear partial differential equation for the one-point probability density function, is solved numerically in various cases. A numerical method of simulation using a regular grid is tested for a small number of vortices. Some very accurate numerical simulations of vortex motion in a circular domain confirm the theoretical conclusions. Dissert. Abstr.

N77-15339 Missouri Univ., Rolla.
MASS TRANSFER IN DISPERSED AND CONTINUOUS PHASES IN NON-NEWTONIAN FLUIDS Ph.D. Thesis
Tuerker Guerkan 1976 254 p
Avail: Univ. Microfilms Order No. 76-26859

The diffusion equation was numerically solved by an implicit finite difference method for the purpose of calculating the continuous phase Sherwood number, for mass transfer from an internally circulating Newtonian droplet traveling through a non-Newtonian power law type continuous phase in the creeping flow regime. The mass transfer-rate to Newtonian fluid spheres in the intermediate Reynolds number region was calculated and is presented. An analysis is presented by which the convective diffusion equations for mass transfer with or without a second order chemical reaction inside a fluid sphere were solved for the purpose of determining the effect of the power law behavior in the dispersed phase on the dispersed phase mass transfer mechanism. Dissert. Abstr.

N77-15340 North Carolina State Univ., Raleigh.
IMPLICIT NUMERICAL SOLUTION OF UNSTEADY FLOWS IN OPEN CHANNELS AND SHALLOW WATER BASINS Ph.D. Thesis
Soor Gul Wardak 1976 130 p
Avail: Univ. Microfilms Order No. 76-28530

Two numerical models are developed to describe the water motion in one and two horizontal spatial dimensions in shallow free surface flows. The first is one dimensional, employs equations of motion for open channel flow and utilizes an implicit finite difference scheme. The second is two dimensional, employs the vertically integrated conservation of mass and momentum equations and utilizes an implicit method. Dissert. Abstr.

N77-15341*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TURBULENCE MODELING FOR COMPRESSIBLE FLOWS
Joseph G. Marvin Jan. 1977 110 p refs
(NASA-TM-X-73188; A-6849) Avail: NTIS HC A06/MF A01 CSCL 20D

Material prepared for a course on Applications and Fundamentals of Turbulence given at the University of Tennessee Space Institute, January 10 and 11, 1977, is presented. A complete concept of turbulence modeling is described, and examples of progess for its use in computational aerodynimics are given. Modeling concepts, experiments, and computations using the concepts are reviewed in a manner that provides an up-to-date statement on the status of this problem for compressible flows. Author

N77-15342# Aeronautical Research Labs., Melbourne (Australia).
CALIBRATION AND CORRECTION OF AN ASYMMETRIC TWO DIMENSIONAL SUPERSONIC NOZZLE

W. H. Schofield Sep. 1975 33 p refs
(ARL/ME-Note-359) Avail: NTIS HC A03/MF A01

Three asymmetric two dimensional supersonic nozzles were designed with nominal Mach numbers of 1.4, 1.6 and 2.0. The Mach 1.4 nozzle was calibrated in detail. The nozzle design was modified to produce a uniform flow field because the formula applied to correct the wall profiles of the nozzle for boundary layer growth was found to be in gross error for this application. The asymmetric design of the nozzle and the necessity for it to operate under free jet conditions accentuated the effects of slight mismatch between the primary and secondary expansion contours with the result that the flow field of the modified nozzle still contained a weak expansion wave. The modified nozzle produced a supersonic jet of Mach number 1.407 plus or minus 1% at distances up to three nozzle heights downstream of exit. Author

N77-15343*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MAGNETIC HEAT PUMPING Patent Application
Gerald V. Brown, inventor (to NASA) Filed 30 Nov. 1976 21 p
(NASA-Case-LEW-12508-1; US-Patent-Appl-SN-746580) Avail: NTIS HC A02/MF A01 CSCL 20D

The magnetic heat pumping method employs ferromagnetic or ferrimagnetic elements, preferably a rare earth based material, such as gadolinium, and preferably employs a regenerator. The temperature and applied magnetic field of the element are controlled to cause the state of the element as represented on a temperature-magnetic entropy diagram repeatedly to traverse a loop. The loop may have a first portion of concurrent substantially isothermal or constant temperature and increasing applied magnetic field, a second portion of lowering temperature and constant applied magnetic field, a third portion of isothermal and decreasing applied magnetic field, and a fourth portion of increasing temperature and constant applied magnetic field. Other loops may be four-sided, with, for example, two isotherms and two adiabats (constant magnetic entropy portions). A regenerator may be employed to enhance desired cooling or heating effects, with varied magnetic fields or varying temperatures including three-sided figures traversed by the representative point. NASA

N77-15344*# Stanford Univ., Calif.
HEAT TRANSFER TO A FULL-COVERAGE FILM-COOLED SURFACE WITH 30 DEGREE SLANT-HOLE INJECTION
M. E. Crawford, W. M. Kays, and R. J. Moffat Washington NASA Dec. 1976 246 p refs
(Contract NAS3-14336)
(NASA-CR-2786; SU-HMT-25) Avail: NTIS HC A11/MF A01 CSCL 20D

Heat transfer behavior was studied in a turbulent boundary layer with full coverage film cooling through an array of discrete holes and with injection 30 deg to the wall surface in the downstream direction. Stanton numbers were measured for a staggered hole pattern with pitch-to-diameter ratios of 5 and 10, an injection mass flux ratio range of 0.1 to 1.3, and a range of Reynolds number Re sub x of 150,000 to 5 million. Air was used as the working fluid, and the mainstream velocity varied from 9.8 to 34.2 m/sec (32 to 112 ft/sec). The data were taken for secondary injection temperature equal to the wall temperature and also equal to the mainstream temperature. The data may be used to obtain Stanton number as a continuous function of the injectant temperature by use of linear superposition theory. The heat transfer coefficient is defined on the basis of a mainstream-to-wall temperature difference. This definition permits direct comparison of performance between film cooling and transpiration cooling. A differential prediction method was developed to predict the film cooling data base. The method utilizes a two-dimensional boundary layer program with routines to model the injection process and turbulence augmentation. The program marches in the streamwise direction, and when a row of holes is encountered, it stops and injects fluid into the boundary layer. The turbulence level is modeled by algebraically augmenting the mixing length, with the augmentation keyed to a penetration distance for the injected fluid. Author

N77-15345*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
REAL-GAS EFFECTS ASSOCIATED WITH ONE-DIMENSIONAL TRANSONIC FLOW OF CRYOGENIC NITROGEN
Jerry B. Adcock Washington Dec. 1976 272 p refs
(NASA-TN-D-8274; L-10810) Avail: NTIS HC A12/MF A01 CSCL 20D

Real gas solutions for one-dimensional isentropic and normal-shock flows of nitrogen were obtained for a wide range of temperatures and pressures. These calculations are compared to ideal gas solutions and are presented in tables. For temperatures (300 K and below) and pressures (1 to 10 atm) that cover those anticipated for transonic cryogenic tunnels, the solutions are analyzed to obtain indications of the magnitude of inviscid flow simulation errors. For these ranges, the maximum deviation of the various isentropic and normal shock parameters from the ideal values is about 1 percent or less, and for most wind tunnel investigations this deviation would be insignificant. Author

N77-15346*# Kanner (Leo) Associates, Redwood City, Calif.
HEAT TRANSMISSION IN HORIZONTAL LIQUID LAYERS
P. L. Silveston Washington NASA Jan. 1977 12 p Transl. into ENGLISH from Forschung auf dem Gebiet des Ingenieurwesens (Dusseldorf), v. 24, 1958 p 29-32
(Contract NASw-2790)
(NASA-TT-F-17370) Avail: NTIS HC A02/MF A01 CSCL 20D

An apparatus for the measurement of heat transmission in horizontal liquid layers with thicknesses from 1.45 to 13.0 mm is described. The layers are uniformly heated from below and cooled from above by Cr-plated Cu disks. Measurements were made with H2O, ethylene glycol, heptane, and 2 types of silicone oil with temperature differences of 1-20 deg. Heat input and output were measured. The experiments show that heat is transmitted by conduction as long as the Rayleigh no. (Ra) remains below Ra sub crit. = 1700 + or - 51. At higher values convection occurs and heat transmission increases up to 6-fold. The results are presented as a graph of Nusselt no. Convection currents were made visible by special illumination and were photographed. Author

N77-15347*# Rockwell International Corp., Canoga Park, Calif. Space Div.
DEVELOPMENT OF THERMAL CONTROL METHODS FOR SPECIALIZED COMPONENTS AND SCIENTIFIC INSTRUMENTS AT VERY LOW TEMPERATURES (FOLLOW-ON) Final Report, 31 Mar. - 30 Nov. 1976
J. P. Wright and D. E. Wilson Nov. 1976 103 p refs
(Contract NAS8-31324)
(NASA-CR-150152; SD-76-SA-0230) Avail: NTIS HC A06/MF A01 CSCL 14B

Many payloads currently proposed to be flown by the space shuttle system require long-duration cooling in the 3 to 200 K temperature range. Common requirements also exist for certain DOD payloads. Parametric design and optimization studies are reported for multistage and diode heat pipe radiator systems designed to operate in this temperature range. Also optimized are ground test systems for two long-life passive thermal control concepts operating under specified space environmental conditions. The ground test systems evaluated are ultimately intended to evolve into flight test qualification prototypes for early shuttle flights. Author

N77-15348# Sandia Labs., Albuquerque, N.Mex.
FREE AND FORCED CONVECTIVE-DIFFUSION SOLUTIONS BY FINITE ELEMENT METHODS
D. K. Gartling and R. E. Nickell 1976 10 p refs Presented at 2d Intern. Symp. on Finite Element Methods in Flow Probl., Rappalo, Italy, 14 Jun. 1976 Sponsored by ERDA
(SAND-76-5270; Conf-760607-1) Avail: NTIS HC A02/MF A01

Several free and forced convective diffusion examples are solved and compared to either laboratory experiment or closed form analysis. The problems solved illustrate the application of finite element methods to both strongly coupled and weakly coupled velocity and temperature fields governed by the steady state momentum and energy equations. Special attention is given to internal forced convection with temperature-dependent viscosity and free convection within an enclosure. ERA

N77-15349# Pennsylvania State Univ., University Park. Applied Research Lab.

A NOTE ON THE INHIBITION OF CAVITATION IN DILUTE POLYMER SOLUTIONS

R. E. A. Arndt, M. L. Billet, J. W. Holl, and C. B. Baker 13 Nov. 1975 20 p refs Presented at the Joint Fluids Eng. and Gas Turbine Conf., New Orleans, 21-25 Mar. 1976

(Contract N00017-73-C-1418)

(AD-A027597; TM-75-285) Avail: NTIS HC A02/A01 CSCL 20/4

Cavitation inception was investigated on a series of hemispherical nosed bodies ranging in diameter from 6.3 mm (1/4 inch) to 203.2 mm (8 inches) in both pure water and dilute aqueous polymer solutions. The desinent value of cavitation index is reduced by as much as 50% on the smaller bodies but the polymer effect is almost negligible on the largest body. There is strong evidence that the favorable effect of polymer addition is due to a reorientation of the flow field near a laminar separation bubble. It is further noted that the effect is probably limited to Reynolds numbers typical of laboratory experiments and would not exist at full scale conditions. GRA

N77-15350# Army Missile Research, Development and Engineering Lab., Redstone Arsenal, Ala. Propulsion Directorate.

TEMPERATURE RESPONSE OF AN INFINITELY THICK SLAB TO RANDOM SURFACE TEMPERATURES

Robert A. Heller 6 May 1976 23 p refs

(DA Proj. 1X3-64307-D-212)

(AD-A027375; RK-76-13) Avail: NTIS HC A02/MF A01 CSCL 20/11

Random process theory has been used to develop statistical relations for the temperature response in an infinitely thick slab when subjected to randomly varying surface temperatures. A realistic seasonal/diurnal temperature cycle with superimposed random hourly variations is used to represent the surface boundary condition. Frequency response, power spectral density, and standard deviation functions are determined as a function of slab depth for various times. For solid propellant material, the temperature drop is very rapid for the diurnal component but is only slightly attenuated for the seasonal cycle. Author (GRA)

N77-15351# Harry Diamond Labs., Adelphi, Md.

FLUERICS 38: A COMPUTER-AIDED DESIGN ANALYSIS FOR THE STATIC AND DYNAMIC PORT CHARACTERISTICS OF LAMINAR PROPORTIONAL AMPLIFIERS

Tadeusz M. Drzewiecki Jun. 1976 65 p refs

(DA Proj. 1T1-61102-AH-44)

(AD-A027587; HDL-TR-1758) Avail: NTIS HC A08/MF A01 CSCL 13/7

This paper presents, in a computer program form, an analysis of laminar proportional amplifiers (LPA's). The equations have been programmed for a 16K-core minicomputer with typewriter graphics capability. Results of the numerical computations for the amplifier port characteristics are presented on a single sheet of computer output in both tabular and graphical form. Tabulated data represented the input characteristic, the output characteristic, the self-staged operating conditions and gain, and the blocked gain. Graphical outputs are the input and output characteristics. Typical calculations are presented for standard types of amplifier configurations. GRA

N77-15352# Army Cold Regions Research and Engineering Lab., Hanover, N.H.

THERMAL INSULATION USING PLASTIC FOAM

W. Greatorex Tobiasson, A. Jul. 1976 15 p refs Transl. into ENGLISH from Statens Inst. for Byggnadsforskning (Sweden), v. 4, 1963 - 1964

(AD-A027408; CRREL-TL-533) Avail: NTIS HC A02/MF A01 CSCL 13/13

Urea foam has in the past few years come into use for improving the thermal insulation in older buildings, as well as in new buildings with faulty insulation. A significant improvement of the insulation in these types of buildings is obtained by injection of plastic foam. The experience is so far rather limited in Sweden. The greatest advantage with this method is that no major re-work is required in the parts of the building which are insulated. Urea foam is manufactured from urea, formaldehyde, foaming agents and a hardener. Manufacture of slab or blocks can be performed in a factory, or the ingredients can be mixed at the construction site and be injected by means of special equipment into the part of the structure which is to be insulated. The curing takes place inside the structure after the material has been injected. The final product is a thermo-setting plastic, which, among other things, means that its hardness is virtually independent of temperature. Author (GRA)

N77-15353# California Univ., Berkeley. Hydraulic Engineering Lab.

TRANSVERSE DISPERSION IN PARTIALLY STRATIFIED TIDAL FLOW Waste Heat Management

Sukru M. Sumer May 1976 236 p refs

(Grant NSF GI-34932)

(PB-256582/8; WHM-20; W76-11486) Avail: NTIS HC A11/MF A01 CSCL 13B

The transverse mixing characteristics of a tidal open channel flow was investigated both for neutrally buoyant flow and a partially stratified flow. The effect of the geometry of the cross-section on lateral mixing was investigated by experiments made in uniform and nonuniform cross-sections. The first part deals with the influence of vertical density stratification on the rate of transverse dispersion without the presence of any transverse circulation. In the second part, the effect of nonuniformity of the cross-sectional area on transverse mixing is investigated; an effect of the nonuniformity is the creation of transverse density gradients and transverse circulation patterns. GRA

N77-15354# Naval Surface Weapons Center, White Oak, Md.

USE OF PHASE-CHANGE PAINTS TO STUDY FIN-BODY INTERFERENCE HEATING

Joseph D. Gillerlain, Jr. 1 Apr. 1976 38 p

(WF32322205)

(AD-A027029; NSWC/WOL/TR-75-62) Avail: NTIS HC A03/MF A01 CSCL 22/2

In recent years the phase-change paint technique has evolved into an accepted diagnostic tool in high-speed wind-tunnel testing. This report documents use of the method at the Naval Surface Weapons Center, White Oak Laboratory, to study aerodynamic interference heating on fin-body configurations. Various aspects of both the underlying theory and the experimental method are enumerated based on experience and on information from other researchers. Analytic relationships are presented which indicate how uncertainties in the various input parameters affect the uncertainty in the heat-transfer coefficient. Advantages and disadvantages of the phase-change paint method are discussed. GRA

N77-15355# Systems Science and Software, La Jolla, Calif.

TRIOIL IV: A THREE DIMENSIONAL HYDRODYNAMICS CODE FOR THE ILLIAC 4 COMPUTER Topical Report, Jan. - Sep. 1975

L. L. Reed and D. R. Henderson Dec. 1975 42 p refs

(Contract DNA001-75-C-0058; DNA Proj. NWET-AAXYX983)

(AD-A027091; SSS-IR-76-2807; DNA-3865T) Avail: NTIS HC A03/MF A01 CSCL 20/4

The TRIOIL IV, 3-D Eulerian hydrodynamic code has been reconfigured from the UNIVAC 1108 to the ILLIAC IV. The code treats two materials and permits valuable zone sizes in three dimensions. The code has been tested with a three-dimensional blast problem with demonstrated gains in running time economy. GRA

N77-15356# Pennsylvania State Univ., University Park. Applied Research Lab.

PROPELLER TIME-DEPENDENT FORCES DUE TO NONUNIFORM FLOW Ph.D. Thesis

David E. Thompson Mar. 1976 228 p refs

(Contract N00017-73-C-1418)

(AD-A026451; TM-76-48) Avail: NTIS HC A10/MF A01 CSCL 20/4

A water tunnel was used to measure the time dependent thrust generated by a series of propellers operating first in various spatially nonuniform inflows and then in various turbulent inflows. The spatial variations were generated by an upstream strut, and the turbulence was generated by square mesh grids placed upstream of the propeller. Three propellers were considered, and

measurements were made with each propeller operating over a range of advance ratios for each nonuniform inflow condition considered. A correlation of the experimental and analytical results is presented. Author

N77-15357# Naval Research Lab., Washington, D.C. Ocean Sciences Div.
DRAFT (NET DISPLACEMENT) PRODUCED BY DENSITY PERTURBATIONS IN STRATIFIED FLUIDS Interim Report
John M. Bergin May 1976 24 p refs
(NRL Proj. K03-54; WF11125703)
(AD-A026232; NRL-8003) Avail: NTIS HC A02/MF A01 CSCL 20/4

We consider the initial-value problem for two-dimensional density perturbations of finite amplitude in an incompressible, viscous, stratified fluid. We demonstrate that evaluation of the 'drift,' or net displacement, field can be reduced to a simple quadrature for a wide class of localized disturbances. Results of possible experimental use are obtained which allow certain characteristics of the initial density perturbation to be deduced from limited knowledge of the drift field and the shape of the region containing the initial density perturbation. Author (GRA)

N77-15358# Naval Postgraduate School, Monterey, Calif. Dept. of Aeronautics.
ON THE STABILITY OF PLANE POISEUILLE FLOW M.S. Thesis
Lewis Raymond Newby Mar. 1976 87 p refs
(AD-A026324) Avail: NTIS HC A05/MF A01 CSCL 20/4

The stability of plane Poiseuille flow was studied using theory developed by Harrison. A similarity transformation was introduced which reduces computation time and provides better insight into the basic relations. The stability of the flow was examined from a Lagrangian viewpoint. Instability was found to be progressive in nature, and three distinct levels were identified, namely incipient, critical, and fully developed instability. Results show that the critical Reynolds number can be lowered indefinitely if certain types of perturbations occur. Specifically these involve relatively abrupt changes in amplitude. This provides a possible explanation for the disagreement between earlier theory and experiment. Author (GRA)

N77-15359# National Aeronautical Establishment, Ottawa (Ontario). Flight Research Lab.
DROP SIZE AND RATE OF PRODUCTION FROM A SPINNING DISC
A. M. Drummond Apr. 1976 51 p refs
(AD-A027465; NAE-LR-590; NRC-15338; ISSN-0077-5541) Avail: NTIS HC A04/MF A01 CSCL 20/4

New experimental results on the primary drop size (d sub p) and rate of drop production are presented. The effects of flow rate (Q), kinematic viscosity (nu) and disc spin rate (omega) on d sub p were measured. It is concluded that d sub p d sub o(nu,Q) = constant/omega. The detached volume has been measured as a function of Q, nu and omega. Both the volume in the primary drop and the detached volume exceed the maximum critical volume of a static pendant drop. This indicates that the dynamics of drop formation must be included when attempting to formulate a predictive model for drop size. The Walton and Prewett model for drop size estimation from a spinning disc is critically examined. Author

N77-15360# Ballistic Research Labs., Aberdeen Proving Ground, Md.
A LEAST SQUARES FINITE ELEMENT APPROACH TO UNSTEADY GAS DYNAMICS Final Report
John F. Polk May 1976 67 p refs
(DA Proj. 1W1-61102-AH-43)
(AD-A026531; BRL-1885) Avail: NTIS HC A04/MF A01 CSCL 20/4

A new numerical technique for solving unsteady gas dynamic equations is presented. The technique is based on least squares finite element concepts with elements that are constructed in both space and time. Both linear and quadratic interpolation is used on individual elements. The technique is tested against a problem whose exact solution is known so that numerical accuracy can be ascertained. GRA

N77-15361# Hawaii Inst. of Geophysics, Honolulu.
MARCHING LONG SURFACE WAVES THROUGH TWO-PORT BASINS. 1: CONTINUOUS CIRCUIT CASE
Rudolph W. Preisendorfer Jan. 1976 106 p refs Sponsored by NOAA
(PB-258058/7; HIG-76-1; NOAA-JTRE-132;
NOAA-76062934) Avail: NTIS HC A06/MF A01 CSCL 08C

The numerical solution of free (unforced) two-dimensional long surface waves in rotating two-port lossy basins of arbitrary shape and size was uniformly carried out by the integration along the basin axis of integro-Riccati equations governing the basin's transport functions, namely the fluid-impedance and fluid-admittance functions. In this way inherently two-dimensional linear fluid motion is analyzed by an initial value method applied to the transport functions of wave amplitude and volume flux. (GRA)

N77-15362# Hawaii Inst. of Geophysics, Honolulu.
MARCHING LONG SURFACE WAVES THROUGH TWO-PORT BASINS. 2: CONTINUOUS TWO-FLOW CASE
Rudolph W. Preisendorfer Feb. 1976 93 p refs Sponsored by NOAA
(PB-258059/5; HIG-76-2; NOAA-JTRE-133;
NOAA-76062935) Avail: NTIS HC A05/MF A01 CSCL 08C

The numerical solution of free (unforced) two-dimensional, time-harmonic, long surface waves in rotating two port lossy basins of arbitrary shape and size was uniformly carried out by the integration along the basin axes of integro-Riccatti equations governing the basins' transport functions. GRA

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N77-15363 Maryland Univ., College Park.
GRAVITATIONAL RADIATION DETECTION Ph.D. Thesis
Gustaf Helmer Bendz Ryobeck 1976 213 p
Avail: Univ. Microfilms Order No. 76-29002

Different forms (strain amplitude) of the equation of motion for a medium responding to a gravitational wave are discussed in relation to the detection of such waves. Expression for optimal sensitivity (and filters) of detector systems are given, including the limit of perfect sensors and electronics. The signal to noise ratio in terms of the spectral power of the gravitational radiation is derived. Long baseline interferometry is discussed. A computer program simulating a pair of Weber type detectors is developed to study different approaches to data analysis. Dissert. Abstr.

N77-15364 Michigan Univ., Ann Arbor.
MULTIPLE EXPOSURE HOLOGRAPHY IN VOLUME MATERIALS Ph.D. Thesis
Steven Kenneth Case 1976 148 p
Avail: Univ. Microfilms Order No. 76-27461

The objectives can be grouped into three categories: (1) extension of the coupled wave theory to include diffraction in multiply-exposed, thick holographic gratings; (2) study of the exposure properties of dichromated gelatin films including multiple exposures and nonlinearities; and (3) combining the diffraction analysis and the film properties study to produce a number of new diffractive optical elements. The coupled wave diffraction theory was extended to include double exposure holographic gratings for the geometry where two gratings have a common central Bragg angle. Closed form analytic solutions for diffraction efficiency are obtained for several readout geometries. The phenomenon of 100% efficient cross-coupling is predicted and experimentally verified. The coupled wave theory for the geometry where two angularly offset gratings are superimposed in one emulsion is then developed. Dissert. Abstr.

N77-15365 Arizona State Univ., Tempe.
INVESTIGATION OF THE SPRAY IMPACT DETECTOR WITH ACTIVE METAL TARGETS Ph.D. Thesis
Michael James Welch 1976 152 p
Avail: Univ. Microfilms Order No. 76-26817

Active metal target electrodes are studied for reverse-phase liquid chromatography. This study employed magnesium, aluminum, zinc, and copper. Most of the work was with a magnesium target and distilled water as the mobile phase. The direction of baseline current generated on the magnesium target by sprayed distilled water was opposite to that generated on the unreactive targets. A mechanism is proposed to explain the observed base-line current based on differences in rate between hydrogen ion reduction and magnesium oxidation on the target surface. This mechanism is supported by experimental data.
Dissert. Abstr.

N77-15366*# Transemantics, Inc., Washington, D.C.
INTERFEROMETER FOR USE IN MINES
P. Ya. Nedviga NASA Nov. 1975 21 p refs Transl. into ENGLISH from Zavod. Lab. (USSR), v. 9, 1940 p 592-602
(Contract NASw-2792)
(NASA-TT-F-16683) Avail: NTIS HC A02/MF A01 CSCL 14B

A Zeiss laboratory interferometer was compared with an interferometer specially designed for use in mines, having a compression compensator system instead of an ocular compensator such as that used in the Zeiss apparatus. It was found that using the compression compensator device, it is possible to eliminate differences between the refractions of the gas being studied and the standard gas, by increasing the pressure in the tube with the standard gas. The operating principle of the compression compensator interferometer is based on interference in pairs of four light beams. The second type of device was found to yield errors of lesser significance than the Zeiss device; it was found to be explosion-proof, mechanically stable, and more convenient in size for use in the mine. Author

N77-15367*# Kanner (Leo) Associates, Redwood City, Calif.
SPECIFIC ELECTRICAL RESISTANCE OF COKE, SEMICOKE, THERMOANTHRACITE AND GRAPHITE POWDERS STUDIED BY A TWO PROBE METHOD
V. V. Gal'pern Dec. 1976 18 p refs Transl. into ENGLISH from Khim. Tuerdogo Topliva (USSR), no. 2, 1973 p 121-128
(Contract NASw-2790)
(NASA-TT-F-17315) Avail: NTIS HC A02/MF A01 CSCL 14B

An apparatus was constructed, and the conditions for the measurement of electrical resistivity of the title materials from 0.00001 to 1 million ohm cm were determined. The error was + or - 1%. The plots of electrical resistivity vs. moisture and electrical resistivity vs. ferromagnetic impurity content of coke and thermoanthracite powders are given. Author

N77-15368*# National Aeronautics and Space Administration. Hugh L. Dryden Flight Research Center, Edwards, Calif.
RESULTS OF A REMOTE MULTIPLEXER/DIGITIZER UNIT ACCURACY AND ENVIRONMENTAL STUDY
Douglas O. Wilner Jan. 1977 49 p refs
(NASA-TM-X-56043) Avail: NTIS HC A03/MF A01 CSCL 14B

A remote multiplexer/digitizer unit (RMDU), a part of the airborne integrated flight test data system, was subjected to an accuracy study. The study was designed to show the effects of temperature, altitude, and vibration on the RMDU. The RMDU was subjected to tests at temperatures from -54 C (-65 F) to 71 C (160 F), and the resulting data are presented here, along with a complete analysis of the effects. The methods and means used for obtaining correctable data and correcting the data are also discussed. Author

N77-15369*# General Electric Co., Philadelphia, Pa. Space Div.
SCANNING MECHANISM STUDY FOR MULTI-FREQUENCY MICROWAVE RADIOMETERS Final Report
Ihsuk Shin 8 Jul. 1976 175 p
(Contract NAS5-22490)
(NASA-CR-144853) Avail: NTIS HC A08/MF A01 CSCL 14B

Scanning mode for a microwave radiometer having large aperture antenna is determined from scientific needs by engineering tradeoffs. Two configurations of the scan drive mechanism with an integral momentum compensation are formulated for 1.0M and 1.4M diameter antennas. As the formulation is based on currently available components, it is possible to design and fabricate the formulated mechanism without new hardware development. A preliminary specification for major components of formulated drives is also included in the report. Author

N77-15370# Goodyear Atomic Corp., Piketon, Ohio.
DIGITAL READOUT ALPHA SURVEY INSTRUMENT
M. E. Jacobs 12 Feb. 1976 26 p refs
(Contract E(33-2)-1)
(GAT-825) Avail: NTIS HC A03/MF A01

A prototype solid state digital readout alpha particle survey instrument has been designed and constructed. The meter incorporates a Ludlum alpha scintillator as a detector, digital logic circuits for control and timing, and a Digilin counting module with reflective liquid crystal display. The device is used to monitor alpha radiation from a surface. Sample counts are totalized over 10-second intervals and displayed digitally in counts per minute up to 19,999. Tests over source samples with counts to 15,600 cpm have shown the device to be rapid, versatile and accurate. The instrument can be fabricated in one man-week and requires about $835 in material costs. A complete set of drawings is included. ERA

N77-15371# National Oceanographic Instrumentation Center, Washington, D.C.
MODEL DDO/MARK V DIGITAL DISSOLVED OXYGEN ANALYZER
Jun. 1976 12 p
(PB-258021/5; IFS-76012) Avail: NTIS HC A02/MF A01 CSCL 08J

Dissolved oxygen is sensed by a gold-silver polarographic membrane type probe that is designed to be automatically temperature compensated. Temperature is sensed by a thermolinear array which uses a PN junction semiconductor device. The sensor outputs are developed as analog signals which are then digitized by automatic-zeroing, commandable dual-slope circuitry which converts at rates of 5 to 7 times per second with appropriate integration for each conversion cycle. Readout is on a 4-digit panel meter switchable for each parameter. This display can be read continuously or made to flash at a fixed rate to conserve power or disabled entirely while operating in a recording mode.
GRA

N77-15372# National Oceanographic Instrumentation Center, Washington, D.C.
BECKMAN FIELDLAB DISSOLVED OXYGEN SYSTEM
Jun. 1976 16 p
(PB-258029/8; IFS-76011; NOAA-76062905) Avail: NTIS HC A02/MF A01 CSCL 08J

The Beckman system is a portable unit designed to measure dissolved oxygen and temperature in situ in fresh water and salt water. Dissolved oxygen is sensed with a platinum-silver polarographic membrane type probe. Three sensors are available: One is a glass unit for sterilized laboratory work; the other two are ruggedized units for in situ or laboratory applications, and one includes a rubber diaphragm for pressure compensation. Temperature is sensed by an optional separate thermistor type probe which is used to set manually a temperature compensation dial on the face of the readout unit. GRA

N77-15373# National Oceanographic Instrumentation Center, Washington, D.C.
DISSOLVED OXYGEN ANALYZER MODEL 330
Jun. 1976 12 p
(PB-258030/6; IFS-76010; NOAA-76062904) Avail: NTIS HC A02/MF A01 CSCL 08J

The dissolved oxygen analyzer system measures dissolved oxygen and temperature in situ in freshwater and saltwater. The system was comprised of the analyzer, a model 61 field probe, and a model 18 stirrer assembly (optional). Dissolved oxygen is sensed with a platinum-lead polarographic membrane type probe that is designed to be automatically temperature compensated.

Temperature is sensed by a thermistor. Data are provided in the form of a visual display on an analog panel meter and through an analog recorder output jack. GRA

N77-15374# Defense Systems Management School, Fort Belvoir, Va.
CONSIDERATIONS IN APPLYING DESIGN TO COST TO THE IMAGE PROCESSING SEGMENT OF THE TACTICAL INFORMATION PROCESSING AND INTERPRETATION (TIPI) PROGRAM
Barbara Rea Craun May 1975 34 p refs
(AD-A027561) Avail: NTIS HC A03/MF A01 CSCL 15/4

Four areas of concern are pursued in this study; specifically, the Tactical Information Processing and Interpretation (TIPI) and the Image Processing (IP) segment are reviewed prior to any attempt to investigate the Design to Cost (DTC) issues. The last two areas addressed are the DTC conceptual framework and the implications of the application of the concept to the IP segment. Of significance in the research of the TIPI and the IP segment is the fact the IP segment is entering full scale development and is considered to be a low risk effort. An equally significant discovery was the fact that there is limited coverage given to the DTC concept in either the Advance Procurement Plan or the statement of work. DTC appears deceptively simple; however, considerable time and effort must be expended by the IP segment office in order to transform the buzz-word into a meaningful concept. The cogent mechanisms which must be used as precursors of the transformation are the Request for Proposal and the contract provisions. Both must be structured to achieve a mutual understanding of not only the concept of DTC but also the specifics that will be required of the contractor.
Author (GRA)

N77-15375# Missouri Univ., Columbia. Dept. of Civil Engineering.
A PORTABLE SELF-MONITORING INSTRUMENT FOR LOAD HISTORY STUDIES Final Report, 8 Aug. 1973 - 30 Jun. 1976
James W. Baldwin, Jr. and Mark W. Williams Mar. 1975 96 p refs Sponsored in part by FHWA. Prepared in cooperation with Missouri State Highway Dept., Jefferson City
(PB-256843/4; FHWA-RD-76-S0512) Avail: NTIS HC A05/MF A01 CSCL 13B

Development and operation of a portable instrument for recording strain events in bridges under field service conditions are described. The instrument consists of a transducer, which is clamped to the flange of a bridge by four allen screws, a set of mechanical counters driven by electronic logic circuitry, a battery pack, and a tamper-proof enclosure. Each counter is incremented every time the strain reaches the triggering level selected for that counter. For the usual case where the triggering levels are all in the elastic range, a simple hand calculation will produce a stress histogram from the counter readings. GRA

N77-15376# National Environmental Satellite Center, Washington, D.C.
ALGORITHM FOR CORRECTING THE VHRR IMAGERY FOR GEOMETRIC DISTORTIONS DUE TO THE EARTH CURVATURE, EARTH ROTATION, AND SPACECRAFT ROLL ATTITUDE ERRORS
Richard Legeckis and John Pritchard Apr. 1976 37 p refs
(PB-258027/2; NOAA-TM-NESS-77; NOAA-76062211) Avail: NTIS HC A03/MF A01 CSCL 14E

An algorithm is reported for approximately correcting the Very High Resolution Radiometer (VHRR) digital data from NOAA's polar orbiting operational environmental satellites for geometric distortions that arise primarily because of the Earth's curvature and rotation and satellite roll attitude errors. The corrections are made along each scan line independently. The algorithm is verified by an intercomparison of VHRR imagery. Several images of the Gulf Stream are included for illustration. GRA

N77-15377# Naval Postgraduate School, Monterey, Calif.
A MAGNETOMETER DATA ACQUISITION SYSTEM M.S. Thesis
Constantine Louis Xefteris Jun. 1976 92 p refs
(AD-A028447) Avail: NTIS HC A05/MF A01 CSCL 17/6

A system for the analysis of geomagnetic and gradient noise is described. The nominal 176 kHz Larmor frequency output of an optically pumped cesium magnetometer is mixed to a frequency in the 1.2 kHz range and FM tape recorded. The recorded output is applied to a periodmeter, the digital output of which is input to the XDS-9300 computer for analysis and display. The absolute accuracy of the period measurement is .75 microsec with a resolution of .25 microsec. The RMS noise of the tape recorder was determined to be .667 microsec or in the operating frequency range less than 1 Hz or .28 gamma. Externally introduced field disturbances as small as .5 gamma were recorded and displayed, and the response time of the magnetometer determined to be less than 2.5 msec. GRA

36 LASERS AND MASERS

Includes parametric amplifiers.

N77-15378 Michigan Univ., Ann Arbor.
NATURAL CONVECTION INDUCED BY A HORIZONTAL LASER BEAM Ph.D. Thesis
Ronald Davie Boyd 1976 164 p
Avail: Univ. Microfilms Order No. 76-27456

The steady state natural convective flow above a horizontal laser beam has been modeled and solved on an approximate basis. The governing boundary layer equations for the plume flow above the laser beam were simplified using similarity. Three dimensional convective and transverse diffusive effects are included. Both integral and numerical solutions were obtained with the approximation that all dependent variables, associated with the plume flow, approach their asymptotic values at the edge of the plume. Solutions are presented as a function of the Prandtl number. Dissert. Abstr.

N77-15379 Rensselaer Polytechnic Inst., Troy, N.Y.
THE FIR WATER VAPOR LASER Ph.D. Thesis
Paul Peter Woskoboinikow 1976 158 p
Avail: Univ. Microfilms Order No. 76-27212

An electric discharge CW water vapor laser oscillating on the 118.6 and 220 micrometers m lines was studied. A technique was developed for determining small signal gain and internal laser losses by using a Michelson coupler to measure the threshold and optimum coupling coefficients. The effect of adding hydrogen and helium was documented. A kinetic model was developed which seems to agree with the observed data. The major features of this model are that the dominant pumping mechanism is by electron impact, the rotational levels are thermalized at the gas temperatures, and the vibrational levels are thermalized at two slightly different temperatures. In terms of this model it appears that hydrogen and helium improve laser gain by cooling the bending mode vibrational temperature. Dissert. Abstr.

N77-15380 Rensselaer Polytechnic Inst., Troy, N.Y.
A PHOTOCHEMICAL STUDY OF NITROGEN DIOXIDE USING A PULSED RUBY LASER Ph.D. Thesis
David Fredrik Hakala 1976 111 p
Avail: Univ. Microfilms Order No. 76-27195

Physical and chemical processes occurring as a result of the interaction between NO2 and light from a high-power, pulsed ruby laser are studied. The absorption of a single quantum of light at a wavelength of 6,943 A raises the NO2 molecule to an excited state where it can fluoresce, be electronically quenched to the ground state or vibrationally deactivate within the excited state manifold prior to either of the above two processes. These various primary processes are studied by time resolution of the emission using a filter-photomultiplier combination and storing the data by photographing the resulting oscilloscope trace. Radiative lifetime and electronic self quenching rate constant at high and low pressures are determined. Dissociation of NO2 by a two step consecutive absorption process is observed. Multiphoton induced emission in the blue spectral range region at high pressure is observed. Dissert. Abstr.

N77-15381*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Government Products Div.
CLOSED-CYCLE GAS DYNAMIC LASER DESIGN INVESTIGATION Final Report

G. W. Ketch and W. E. Young Jan. 1977 176 p refs
(Contract NAS3-19705)
(NASA-CR-135130; PWA-FR-7605) Avail: NTIS HC A09/MF A01 CSCL 20E

A conceptual design study was made of a closed cycle gas-dynamic laser to provide definition of the major components in the laser loop. The system potential application is for long range power transmission by way of high power laser beams to provide satellite propulsion energy for orbit changing or station keeping. A parametric cycle optimization was conducted to establish the thermodynamic requirements for the system components. A conceptual design was conducted of the closed cycle system and the individual components to define physical characteristics and establish the system size and weight. Technology confirmation experimental demonstration programs were outlined to develop, evaluate, and demonstrate the technology base needed for this closed cycle GDL system.
Author

N77-15382*# Illinois Univ., Urbana. Radio Research Lab.
ATMOSPHERIC REFRACTION ERRORS IN LASER RANGING SYSTEMS Final Report
C. S. Gardner and J. R. Rowlett Nov. 1976 52 p refs
(Grant NsG-5049)
(NASA-CR-149281; UILU-ENG-77-2538; RRL-Publ-477) Avail: NTIS HC A04/MF A01 CSCL 20E

The effects of horizontal refractivity gradients on the accuracy of laser ranging systems were investigated by ray tracing through three dimensional refractivity profiles. The profiles were generated by performing a multiple regression on measurements from seven or eight radiosondes, using a refractivity model which provided for both linear and quadratic variations in the horizontal direction. The range correction due to horizontal gradients was found to be an approximately sinusoidal function of azimuth having a minimum near 0 deg azimuth and a maximum near 180 deg azimuth. The peak to peak variation was approximately 5 centimeters at 10 deg elevation and decreased to less than 1 millimeter at 80 deg elevation.
Author

N77-15383# Sandia Labs., Albuquerque, N.Mex.
FISSION FRAGMENT PUMPING OF CO GAS MIXTURES: EXPERIMENTS, AND UNRESOLVED PHYSICS QUESTIONS
David A. McArthur 1976 13 p refs Presented at Nucl. Pumped Laser Workshop, Monterey, Calif., 6 Apr. 1976 Sponsored by ERDA
(SAND-76-5308; Conf-760438-1) Avail: NTIS HC A02/MF A01

A review of the Sandia program for developing nuclear pumped lasers is presented. Emphasis is placed on the CO/Ar mixture.
ERA

N77-15384# Sandia Labs., Albuquerque, N.Mex.
RECENT STUDIES OF RARE-GAS-HALOGEN LASER SYSTEMS AT SANDIA
G. C. Tisone, J. M. Hoffman, and A. K. Hays 1976 3 p Presented at LASL-LIS Conf., Albuquerque, N. Mex., 13 Apr. 1976 Sponsored by ERDA
(SAND-76-5321; Conf-760439-1) Avail: NTIS HC A02/MF A01

Diatomic rare gas halide systems are of great interest because they offer promise as a new class of powerful partially tunable ultraviolet lasers which will be useful for photochemistry. Using electron-beam excitation of rare-gas-halogen mixtures, XeF (3430 A), XeCl (3080 A), XeBr (2818 A), KrF (2484 A) and ArF (1932 A) have been made to lase. Of these systems, KrF, ArF and XeF are the most efficient. Operating characteristics of the lasers are discussed.
ERA

N77-15385# Harry Diamond Labs., Adelphi, Md.
LASER TERMINAL HOMING ENGAGEMENT SIMULATOR (EYE-SAFE)
Thomas James Gleason and Melvin Ernest Sword 1976 15 p refs
(AD-A026002) Avail: NTIS HC A02/MF A01 CSCL 06/18

The Laser Terminal Homing Engagement Simulator (LATHES) was developed for the U.S. Army Operational Test and Evaluation Agency by the Harry Diamond Laboratories (Army Materiel Development and Readiness Command) for use in test and training exercises involving laser terminal homing systems. In the U.S. Army these systems include the Cannon Launched Guided Projectile (CLGP), Helicopter Laser Fire and Forget Missile (HELLFIRE), Ground Laser Locator/Designator (GLLD), Airborne Target Acquisition and fire control systems (ATAFCS), Light Weight Laser Designator (LWLD), and Airborne Laser Tracker (ALT). The most important feature of LATHES is that it makes it possible to conduct a realistic field simulation of a tactical laser terminal homing engagement without using any components that pose a hazard to the eyes of user or bystander personnel. All LATHES components are eyesafe at zero range.
GRA

N77-15386# Army Missile Research, Development and Engineering Lab., Redstone Arsenal, Ala.
DESCRIPTION AND OPERATION OF THE MOBILE DEIONIZED WATER SUPPLIER (MDWS) FOR THE MOBILE TEST UNIT (MTU)
Dean C. Reese 27 May 1976 14 p
(DA Proj. 1X3-63314-D-093)
(AD-A027056; RL-76-23) Avail: NTIS HC A02/MF A01 CSCL 13/6

This report explains the design and operation of the Mobile Deionized Water Supplier (MDWS), which is a support module for the operation of the Laser Cooling Module (LCM) and the Mirror Temperature Regulating Module (MTRM) of the Mobile Test Unit (MTU). The purpose of the MDWS is to store, circulate, and distribute water for flushing and charging operations on the LCM and MTRM while the MTU is operating under range testing procedures. This hardware is essential to the successful range operations of the MTU.
Author (GRA)

N77-15387# Rome Air Development Center, Griffiss AFB, N.Y.
MICROWAVE CAVITY DIAGNOSTICS OF CO2 LASER EFFECTS ON THE DIELECTRIC PROPERTIES OF SELECT MATERIALS
K. V. N. Rao May 1976 31 p refs
(AF Proj. 2153)
(AD-A027661; RADC-TR-76-163) Avail: NTIS HC A03/MF A01 CSCL 11/2

A variety of dielectric samples such as Cordopreg (E293), Slip-Cast Fused Silica (SCFS), Impregnated Slip-Cast Fused Silica (ISCFS), Pyroceram (Corning 9606), Silicon Nitride (SN), and Impregnated Silicon Nitride (ISN) were individually placed in a microwave cavity resonating approximately at 6 GHz in the TE111 mode. These samples are irradiated by a cw, 10.6 micron laser beam for less than 5 sec and with a power density up to 1,000 w/sq cm. The complex permittivity of the samples was determined during and after irradiation by standard microwave cavity perturbation techniques. The technique is found to be a sensitive method to measure small and rapid changes of the loss tangent of the dielectric. The sensitivity is dependent on the quality factor of the cavity, and the rapidity of detection is limited by how fast the sweep oscillator can be swept through the resonance. Microwave absorptivity of all samples increased during laser irradiation for intensities greater than 60 w/sq cm. Cordopreg has shown considerable mechanical, electrical and physical damage both during and after laser irradiation. Considerable specular reflection of laser radiation was observed from silicon nitride and impregnated silicon nitride samples.
Author (GRA)

N77-15388# AeroChem Research Labs., Inc., Princeton, N.J.
KINETIC MEASUREMENTS ON THE FATE OF ELECTRONICALLY EXCITED BaO FROM THE Ba/N2O CHEMICAL PUMPING REACTION Final Report
William Felder, Robert K. Gould, and Arthur Fontijn Apr. 1976 52 p refs Sponsored in part by ARPA
(Contract F29601-74-C-0092)
(AD-A028300; TP-325; AFWL-TR-75-218) Avail: NTIS HC A04/MF A01 CSCL 07/4

There is a vital interest in an effective high-power visible laser. As pumps for such lasers, highly exothermic chemiluminescent metal atom oxidation reactions offer considerable promise. Most of the research on such reactions has been devoted to the kinetics of emitter formation, photon yield measurements and spectral analysis. However, to optimize a system for possible use as a visible laser, it is also necessary to know the rates at

which species expected to be present in an operational laser quench and vibrationally relax the emitting electronic state, and to know the rate at which these species deplete the lower laser level. In the present work, rate coefficients for the electronic quenching and vibrational relaxation of the potential upper lasing state have been measured for BaO(A singlet Sigma), formed in the reaction, Ba + N2O to BaO + N2, using Ar, He, N2, O2, N2O, and Ba as the quenching/relaxation agents. BaO from reaction (1) was studied because this reaction offered the most promise of the candidate pumping reactions discovered at the time this work was initiated. GRA

N77-14988# Defence Research Establishment Valcartier (Quebec).
TRANSVERSELY EXCITED ATMOSPHERE (TEA): CO2 LASER DEVELOPMENT AND APPLICATIONS
J. Gilbert *In* AGARD 11th AGARD Ann. Meeting Feb. 1976 p 45-57 (For primary document see N77-14982 06-01)
Avail: NTIS HC A04/MF A01

37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

N77-15389 Michigan State Univ., East Lansing.
A THERMO-METALLURGICAL MODEL PREDICTING THE STRENGTH OF WELDED JOINTS USING THE FINITE ELEMENT METHOD Ph.D. Thesis
Gary William Krutz 1976 111 p
Avail: Univ. Microfilms Order No. 76-27123

A finite element computer model was developed and used to determine the time temperature history of a butt weld as related to the heat input. Variables affecting this cooling time include metallurgical constituents, radius of the heat flux, velocity of the arc, and thermal conductivity of molten steel. Thermal conductivity and specific heat were considered as a function of temperature. The latent heat of fusion, and radiation and convection heat transfer were included in the model. A Gaussian distributed heat flux was assumed. Dissert. Abstr.

N77-15390 North Carolina State Univ., Raleigh.
OPTIMIZATION OF LOAD CARRYING CAPACITY FOR A SECTOR THRUST BEARING Ph.D. Thesis
Selcuk Ismail Gueceri 1976 85 p
Avail: Univ. Microfilms Order No. 76-28483

Equations are developed by assuming constant viscosity and incompressible lubricants. It is also assumed that the lubricant film thickness be sectionally constant and has either the minimum or a specified value. The stability and other difficulties arising from the numerical solutions are discussed. The formulations for the variable film thickness case are also developed. Equations are solved numerically for a sample case with constant lubricant film thickness. Comparisons are given with the similar problems available in the literature. Dissert. Abstr.

N77-15391 Wisconsin Univ., Madison.
NITROGEN OXIDE CONTROL WITH THE DELAYED MIXING STRATIFIED CHARGE ENGINE CONCEPT Ph.D. Thesis
Lawrence William Evers 1976 267 p
Avail: Univ. Microfilms Order No. 76-20662

A study of existing engines shows that some operational stratified charge engines limit nitrogen oxide emissions in a manner similar to the delayed mixing concept. These engines and the delayed mixing concept have lower nitrogen oxide emissions near stoichiometric fuel-air ratios and are less sensitive to changes in fuel-air ratios. Other engines tend to have the most nitrogen oxide emissions near stoichiometric fuel-air ratios. Dissert. Abstr.

N77-15392 Georgia Inst. of Tech., Atlanta.
LIGHT-SCATTERING STUDY OF THE GLASS TRANSITION AND THE GLASSY STATE IN LUBRICATING OILS Ph.D. Thesis
Mohammed Ahmad Alsaad 1976 189 p
Avail: Univ. Microfilms Order No. 76-29353

The glass transition temperature is considered as a function of pressure for four lubricants (polyphenyl ether, cycloaliphatic hydrocarbon, naphthenic base oil, and naphthenic base oil blended with 2.2 percent high molecular weight polymer) as measured by the light-scattering technique. The light source was a CRL Argon ion laser having a power of about 200 m watt in single frequency operation at 5,145 A. This technique allows the measurements of the sound velocity in materials as a function of pressure and temperature. The change in slope of the sound velocity as a function of pressure or temperature allows the determination of the glass transition. The maximum pressure attained was 100 kpsi, and the temperature range varied from 76 to 210 F. Dissert. Abstr.

N77-15393 Columbia Univ., New York.
KINEMATIC DESIGN OF CAM-FOLLOWER SYSTEMS Ph.D. Thesis
Hitoshi Tanaka 1976 230 p
Avail: Univ. Microfilms Order No. 76-29116

One particularly interesting application of a constant breadth cam trapped in a square follower is its use in a mechanical linkage as a joint element. Such a kinematic pair, which may be called a constant breadth pair, allows motion modifications of linkages not easily obtainable from standard turning and prismatic pairs. The motion equations are derived and several examples are presented. Dissert. Abstr.

N77-15394 Columbia Univ., New York.
GAS-LUBRICATED POROUS BEARINGS, INFINITELY-LONG, SHORT AND FINITE BEARINGS Ph.D. Thesis
Erh-Rong Wu 1976 123 p
Avail: Univ. Microfilms Order No. 76-28317

The general governing equations for finite porous journal bearings with compressible lubricants and slip flow are derived. A mass content rule is developed for infinitely long porous bearings; an exact solution is established for a gas-lubricated porous bearing with very large bearing number consistent with the mass content rule. An analytical numerical technique which takes advantage of the linearity of the pressure equation in the porous medium is developed to solve the problem of finite values of compressibility. Dissert. Abstr.

N77-15395 Wisconsin Univ., Madison.
KINEMATIC AND KINETIC ANALYSES OF SPATIAL MECHANISMS AND VIBRATION ANALYSIS OF ELASTIC LINKAGES Ph.D. Thesis
Youngil Youm 1976 437 p
Avail: Univ. Microfilms Order No. 76-20700

In the vibration analysis, vibratory responses of elastic linkages are studied by the dynamic influence coefficient method for the unperturbed motion and Mitropolskii's asymptotic solution method for the perturbed motion. Investigations of an elastic slider crank mechanism and an elastic four bar linkage are presented. Dissert. Abstr.

N77-15396# Polish Academy of Sciences, Warsaw.
LIMITAL STATICALLY PERMISSIBLE DISCONTINUOUS STRESS FIELDS FOR ESTIMATING LIMITAL LOAD CAPACITY, PART 1 [GRANICZNE STATYCZNIE DOPUSZCZALNE NIECIAGLE POLA NAPREZEN DLA SZACOWANIA NOSNOSCI GRANICZNEJ, CZESC 1]
W. Szczepinski 26 Mar. 1976 59 p refs In POLISH
Avail: NTIS HC A04/MF A01

Durability and optimization of machine and construction elements were studied along with elementary discontinuous stress fields in a limited state. Complex statically permissible systems of stresses can be constructed from constituent elements for determining the lower estimate of limital load capacity and estimating the optimal form of construction elements with complicated shapes. Theoretical solutions for basic systems of lines of discontinuity and elementary stress fields, along with a series of examples of the application for flat machine elements and three dimensional rolling-mill constructions are presented. Author

N77-15397*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
POSITIVE ISOLATION DISCONNECT Patent Application
Morley V. Friedell, inventor (to NASA) (Martin Marietta Corp.,

Denver) Filed 15 Dec. 1976 18 p
(Contract NAS9-14376)
(NASA-Case-MSC-16043-1; US-Patent-Appl-SN-750792) Avail: NTIS HC A02/MF A01 CSCL 13K

A disconnect composed basically of two halves each consisting of a poppet valve operable to isolate fluid with essentially zero fluid loss is described. The two halves are coupled together by a quickly releasable coupling, which may be either a coupling ring tightened or loosened by a twisting motion, or a clamp operated by a pivoted handle. In either case an interlock device is provided to prevent disconnecting the two halves until both valves are in closed condition. The positive feature of the device is one requiring a valve closing step before a disconnect step, and takes structural form in an eccentric lobe mounted on the valve operating stem. If some obstruction prevents the poppet from moving to its seat, the eccentric lobe cannot be rotated to the closed position, and the interlock prevents a disconnect. NASA

N77-15398# Technische Hogeschool, Delft (Netherlands).
PLATE SPRING MECHANISM WITH CONSTANT NEGATIVE STIFFNESS
J. VanEijk and J. F. Dijksman Jun. 1976 18 p refs
(WTHD-86) Avail: NTIS HC A02/MF A01

A spring with negative stiffness is discussed where the action is based on the instability of the second order buckling state of a flat plate spring clamped at both sides. The action of this negative spring is independent of gravity. The mechanism contains no sliding parts. Author

N77-15399# Technische Hogeschool, Delft (Netherlands).
DYNAMIC ANALYSIS OF PLANAR MECHANISMS WITH RIGID LINKS
K. VanderWerf Apr. 1976 28 p refs
(WTHD-85; Rept-583) Avail: NTIS HC A03/MF A01

Finite element analysis on planar mechanisms leads to a useful description of kinematic and dynamic behavior. The underlying theory is presented, and realization in a computer program with some applications is discussed. Author

N77-15400*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ACTUATOR MECHANISM Patent Application
William C. Stange, inventor (to NASA) Filed 6 Dec. 1976 28 p
(NASA-Case-GSC-11883-2; US-Patent-Appl-SN-747675) Avail: NTIS HC A03/MF A01 CSCL 13I

An actuator mechanism is presented having a shaft rotatably supported in the frame. A positioning mechanism is coupled to the shaft for rotating the shaft in two rotary positions disposed approximately 180 deg apart. A pair of plungers are coupled to the shaft, each of which is responsive to a control signal for applying bi-directional rotation to the shaft respectively. NASA

N77-15401# General Electric Co., Schenectady, N.Y. Gas Turbine Products Div.
HIGH TEMPERATURE GAS TURBINE ENGINE COMPONENT MATERIALS TESTING PROGRAM Quarterly Technical Progress Report, 28 Sep. 1975 - 2 Jan. 1976
S. M. Kaplan 15 Jan. 1976 65 p
(Contract E(49-18)-1765)
(FE-1765-7; QTPR-2) Avail: NTIS HC A04/MF A01

Selection of materials to be tested and the preparation of test specimens of these have been completed. Coal feedstocks to be used for low Btu gas tests and also requirements for both samples of these and acquisition of data during initial low Btu gas testing have also been completed. Test facility and test specimen arrangements for initial coal-derived liquid fuel tests are complete and have been checked out. ERA

N77-15402# Sandia Labs., Albuquerque, N.Mex. Engineering Div.
MAVIS: A COMPUTER PROGRAM FOR THE MODELING AND ANALYSIS OF EXPLOSIVE VALVE INTERACTIONS
R. Ng Feb. 1976 51 p refs
(Contract AT(29-1)-789)
(SAND-75-8018) Avail: NTIS HC A04/MF A01

The computer program MAVIS was developed to model the interactions involved in explosively actuated valves. Comparisons of the calculated results with available data have shown the feasibility of using MAVIS for analytical studies of valve interactions. The code can be used for design purposes as well as analytical studies and will now be used to analyze the operation of sealing valves, study the effectiveness of new actuators, and perform a parametric study of the operation of valves. ERA

N77-15403# Massachusetts Inst. of Tech., Cambridge. Dept. of Materials Science and Engineering.
MACHINE CASTING OF FERROUS ALLOYS Interim Report, 1 Jul. - 31 Dec. 1975
W. C. Flemings, K. P. Young, and R. G. Riek May 1976 17 p refs
(Contract DAAG46-73-C-0110; ARPA Order 2267)
(AD-A027464; AMMRC-CTR-76-15; IR-4) Avail: NTIS HC A02/MF A01 CSCL 13/8

Major emphasis was on the development of the Thixocasting process. The Continuous Rheocaster was modified to improve performance and a Softness Indicator was developed to control the Thixocasting reheating stage, thereby eliminating thermocouples. Following production of more than 1,000 pounds of the model Copper Alloy 905, more than 800 pounds of AISI 440C and 304 stainless steel was Rheocast in ingot form. Charges, cut from these ingots, were used to produce more than 500 Thixocastings in the copper alloy and over 400 stainless steel Thixocastings. In the course of the work, casting parameter optimization has shown that good Thixocasting practice for these alloys requires equivalent or lower casting pressures than conventional liquid practice and considerably lower metal ingate velocities. GRA

N77-15404# Rhode Island Univ., Kingston. Div. of Engineering Research and Development.
PERFORMANCE EVALUATION OF CERAMIC MATERIALS AND ASPECTS OF SURFACE PREPARATION FOR GAS-BEARINGS Final Technical Report, 1 Sep. 1974 - 30 Aug. 1975
Thomas J. Rockett, Peter J. Gielisse, O. B. Damani, K. Kulkarni, P. W. Smith (Admiralty Compass Obs., Slough, England), and A. G. Patterson (Admiralty Compass Obs., Slough, England) Dec. 1975 107 p refs
(Contract N00014-75-C-0226)
(AD-A027700; Rept-98-04-4046C) Avail: NTIS HC A06/MF A01 CSCL 13/9

In the first part of this report, silicon nitride and boron carbide were the materials studied for their friction and wear properties. Boron carbide in air gave an average coefficient of friction of 0.11 + or - 0.1, but values as low as 0.03 were observed under certain conditions. Surface chemistry plays a critical role in determining the coefficient values. Wear yielded surface-active debris which became more dense to form packed surface layers. The behavior of these surface layers determines the coefficient of friction. Silicon nitride yielded more wear debris and gave very short stable runs. Packed surface layers were also observed. Coefficients of friction from 0.4 to 0.04 were measured. The most frequently observed value in air was 0.28. In a separate work (Part II) an in-depth study of the surface preparation for gas bearings was done. Surface finish, which results from a complex interaction between system and material, has a very important influence on the performance of the gas bearings. GRA

N77-15405# Metaalinstitut TNO, Apeldoorn (Netherlands). Dept. of Surface Treatment and Tribology.
STUDY OF THE LUBRICATION MECHANISM OF THIN FILM LUBRICATED CONCENTRATED STEEL CONTACTS Final Technical Report, Mar. 1975 - Mar. 1976
A. Begelinger and A. W. J. DeGee Mar. 1976 36 p refs
(Grant DA-ERO-75-G-050; DA Proj. 1T1-61102-B-35E)
(AD-A026945) Avail: NTIS HC A03/MF A01 CSCL 11/8

The lubrication mechanism of fully submerged sliding point contacts of AISI 52100 steel has been studied as a function of surface roughness, type of additive and type of cover gas. Strong indications are found that, at relatively low values of normal load and sliding speed, a thin lubricant film (incompletely) separates the surfaces. This thin film survives asperity contacts because newly-formed contacts oxidize rapidly. Collapse of the

lubricant film occurs if oxidation can no longer keep ahead of the formation of new asperity contacts. Increasing surface roughness and decreasing oxygen content of the lubricant both cause a reduction in load carrying capacity. At low speed of sliding collapse of the thin lubricant film leads to 'boundary lubrication'. At high values of load, breakdown of this boundary film occurs which leads to severe wear (scuffing). This effect may perhaps be associated with a metallurgical transformation in the steel at a particular value of the conjunction temperature. Surface roughness and oxygen content of the lubricant do not influence the load carrying capacity of the boundary film. At relatively high values of sliding speed collapse of the thin lubricant film directly leads to severe wear. In an oxygen containing lubricant, zinc dialkyldithiophosphate improves the load carrying capacity of both the lubricant film and of the boundary film. Dobenxyl disulfide only manifests itself in the boundary region. In an oxygen free lubricant the role of the additive is much more limited. GRA

N77-15406# State Univ. of New York, Stony Brook. Dept. of Materials Sciences.
THE RESPONSE OF COATED STEELS TO CAVITATION IN CORROSIVE ENVIRONMENTS
C. M. Preece, H. Herman, V. Wilms, S. Safai, and J. Fauty May 1976 28 p refs
(Contract N00014-75-C-1018; NR Proj. 036-110)
(AD-A026293; TR-1) Avail: NTIS HC A03/MF A01 CSCL 11/3

The investigation under this contract was initiated in June 1975 to provide some understanding of the mechanism(s) of deterioration of plasma sprayed coatings by erosion and/or corrosion. It is apparent that such an understanding will require an extensive long range investigation covering a wide range of coatings and of erosive and corrosive environments. However, in order to allow the problem areas to be defined, attention has been focussed on a single ceramic coating, alumina, and a single metallic coating, aluminum, both on steel substrates. In the initial phase of this program, emphasis has been on the structural and mechanical characterization of the coating itself with some preliminary studies of their response to cavitation. GRA

N77-15407# Naval Postgraduate School, Monterey, Calif.
MICROPROGRAMMABLE DATA ACQUISITION AND PROBE CONTROL SYSTEM (MIDAS 4) WITH APPLICATION TO COMPRESSOR TESTING M.S. Thesis
Dennis Delane Patton Mar. 1976 181 p refs
(AD-A027242) Avail: NTIS HC A09/MF A01 CSCL 09/4

The construction and use of a programmable, fully automatic data acquisition and control system (MIDAS 4) is reported with application to probe surveys in a turbomachine. The MIDAS 4 system was designed to record up to 48 channels of analog data, position and align a pneumatic probe in the direction of flow in surveys across a flow passage, and control the operation of up to four Scanivalve pneumatic switches. The MIDAS 4 input and output is presently via a teletypewriter keyboard and paper-tape punch. A direct interface with the Hewlett-Packard HP 9830A calculator is a logical modification of the system. Author (GRA)

N77-15408# GARD, Inc., Niles, Ill.
INSPECTION OF NUCLEAR REACTOR WELDING BY ACOUSTIC EMISSION
D. W. Prine Oct. 1976 33 p
(Contract AT(49-24)-0187)
(PB-258128/8; NUREG-0035-2) Avail: NTIS HC A03/MF A01 CSCL 18J

Experimental acoustic emission data on simulated nuclear pressure vessel welds are presented. Some analysis of this data is included, however, the analysis is incomplete due to the current unavailability of confirming NDE and metallographic results. GRA

N77-15409# Military Academy, West Point, N.Y. Dept. of Engineering.
EFFECTS OF A THERMAL REACTOR ON THE ENERGY EFFICIENCY OF A TURBOCHARGED, STRATIFIED CHARGE ENGINE
Oleh B. Koropey and Paul J. Kern 1976 15 p refs
(AD-A026059) Avail: NTIS HC A02/MF A01 CSCL 21/7

Since 1963 the United States Army Tank Automotive Command (USATACOM) and Texaco Incorporated have been developing a fuel efficient, multi-fuel, low specific emission engine. In the last phase of the project high specific power has been sought through turbocharging. Based on prior work a project under the auspices of the Dean's Office for Scientific Research at the United States Military Academy was initiated in the Department of Engineering. The objective was to assess the effect of a thermal reactor on the turbocharged version of the Texaco Controlled Combustion System (TCCS) L141 through analytical and experimental techniques. A thermal reactor is considered contrary to good turbocharged exhaust system design due to internal baffles, large cross sectional area, and long flow path; however, it was felt that a reactor might extract some additional work from the gases to offset these aspects. GRA

N77-15410# Southwest Research Inst., San Antonio, Tex.
LUBRICANT/METALLURGY INTERACTION EFFECTS ON TURBINE ENGINE LUBRICANT LOAD RATING Final Report, 1 Mar. 1973 - 1 Mar. 1976
P. M. Ku, H. E. Staph, H. J. Carper, and E. L. Anderson 1 Mar. 1976 229 p refs
(Contract F33615-73-C-2027; AF Proj. 3048)
(AD-A026208; SwRI-RS-638; AFAPL-TR-76-27) Avail: NTIS HC A11/MF A01 CSCL 21/5

This investigation has as its objective the development of an improved methodology for aircraft power spur gear design, with primary emphasis on gear-tooth scuffing (scoring) and secondary emphasis on gear-tooth pitting (surface fatigue). Toward this end, mathematical models are proposed for scuffing and pitting, as well as for another relevant but less important failure mode, rubbing wear. Basic data for the scuffing and pitting models were derived from sliding-rolling disk tests using the AFAPL disk tester. Gear scuffing and pitting tests were also performed, using two WADD gear machines, to evaluate the validity of the two models. The scuffing model was found to yield scuff-limited gear power-transmitting capacities to about five percent of the actual. However, the several correlating factors employed in the model require independent confirmation and rationalization. The pitting model was found to yield gear pitting lives about ten times the actual, due principally to the weak statistical base of the quantitative data available and also a lack of basic understanding of the pitting process in gears. The wear model, which is not within the scope of this investigation, was not tested. The investigation has revealed many areas where basic understanding or quantitative data are still inadequate. Recommendations for additional research are presented. Author (GRA)

N77-15411# General Electric Co., Schenectady, N.Y. Gas Turbine Products Div.
WATER COOLED GAS TURBINE DEVELOPMENT Annual Report
A. H. Perugi Jan. 1976 114 p
(EPRI Proj. 234-2)
(PB-257656/9; EPRI/AF-231) Avail: NTIS HC A06/MF A01 CSCL 21E

The objectives of this program on project 234-2 are: to perform tests to evaluate the ability of water cooled, ultrahigh temperature, heavy duty gas turbine hardware to resist erosion; to conduct a design analysis of water cooled, ultrahigh temperature, heavy duty gas turbine components; to study the rates and compositions of deposits and the methods for modification or removal of such deposits; and to conduct materials corrosion tests in an environment representative of that expected in the hot sections of an ultrahigh temperature heavy duty gas turbine. GRA

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N77-15412# Army Tropic Test Center, APO New York 09827.
MATERIEL TESTING IN THE TROPICS

Feb. 1976 217 p refs
(AD-A027409; USATTC-7602001) Avail: NTIS HC A10/MF A01 CSCL 15/5

The US Army Tropic Test Center presents the 1976 update of Materiel Testing in the Tropics. The handbook is a compendium of the US Army's experience in testing equipment in the humid tropics. Sources of information are tropic materiel tests, test methodology investigations, personal experiences, open literature, Department of Defense reports, and voluntary contributions from many scientists and engineers outside of USATTC. The document is the US Army's unofficial corporate memory of tropic materiel testing and is aimed directly at the scientists and engineers in the Army's development centers and test agencies. Topics covered include the Panama Canal Zone environment, history of tropic tests, degrading environmental factors, materiel degradation, tropic reliability and maintainability, vehicular mobility testing sound, visibility, radio propagation, human factors engineering, man-pack portability, and computerized test site selection methods. This document should provide valuable information for those who design, use, or test equipment for eventual deployment in the humid tropics of the world. It includes significant bibliographies of USATTC test and technical reports.
Author (GRA)

N77-15413# Raytheon Co., Huntsville, Ala. Dept. of Life Cycle Analysis.
MISSILE MATERIEL RELIABILITY PREDICTION HANDBOOK. PARTS COUNT PREDICTION Final Report, Jun. 1974 - Jun. 1976
Dennis F. Malik, Joe C. Mitchell, Richard E. Cordray, and Oscar L. Soler May 1976 292 p refs
(Contract DAAH01-74-C-0853)
(AD-A026104; LC-76-1) Avail: NTIS HC A13/MF A01 CSCL 16/1

This handbook provides failure rates and reliability models to predict the life cycle reliability of missiles. The reliability prediction methodology uses the 'parts count' approach where average failure rates are given for classes of devices which can be directly input to the reliability model. Storage (non-operating) and operating failure rates are available for electronic, electrical electromechanical, ordnance, hydraulic and pneumatic devices. As an example, a reliability prediction is made for a hypothetical missile. GRA

N77-15414# Stanford Research Inst., Menlo Park, Calif.
PHOTOOXIDATION AND ACCELERATED TESTING OF POLYPROPYLENE Final Report, 1 Jul. 1973 - 18 Jun. 1976
Frank R. Mayo, Harold Richardson, and Theodore Mill Jul. 1976 49 p refs
(Contract DAHC04-73-C-0035; DA Proj. 2O0-61102-B-13B) (AD-A027447; ARO-11337.1-C) Avail: NTIS HC A03/MF A01 CSCL 11/9

The ultimate objective of the research described here was to devise an accelerated test to predict the useful lives of stabilized polypropylene (PP) resins exposed to sun and weather. The point of departure was a study of radical-initiated oxidations of polyolefins in the dark at 20 C to 55 C; 90% of the oxygen consumed was accounted for, and a simple mechanism was consistent with the products. Author (GRA)

N77-15415# Raytheon Co., Huntsville, Ala. Dept. of Life Cycle Analysis.
STORAGE RELIABILITY OF MISSILE MATERIEL PROGRAM, MONOLITHIC BIPOLE SSI/MSI DIGITAL INTEGRATED CIRCUIT ANALYSIS Final Report, Jun. 1974 - Jun. 1976
Dennis F. Malik May 1976 108 p refs
(Contract DAAH01-74-C-0853)
(AD-A026123; LC-76IC1) Avail: NTIS HC A06/MF A01 CSCL 09/5

This report documents findings on the non-operating reliability of monolithic bipolar SSI/MSI digital integrated circuits. Real time storage and accelerated testing results were analyzed and integrated to develop a non-operating reliability prediction model. Failure mechanisms are also discussed in detail. This information is part of a research program being conducted by the U.S. Army Missile Command, Redstone Arsenal, Alabama. The objective of this program is the development of non-operating (storage) reliability prediction and assurance techniques for missile materiel. Author (GRA)

N77-15416# Raytheon Co., Huntsville, Ala. Dept. of Life Cycle Analysis.
STORAGE RELIABILITY OF MISSILE MATERIEL PROGRAM; MONOLITHIC BIPOLAR SSI/MSI LINEAR INTEGRATED CIRCUIT ANALYSIS Final Report, Jun. 1974 - Jun. 1976
Dennis F. Malik May 1976 70 p refs
(Contract DAAH01-74-C-0853)
(AD-A026179; LC-76-IC2) Avail: NTIS HC A04/MF A01 CSCL 09/5

This report documents findings on the non-operating reliability of monolithic bipolar SSI/MSI linear integrated circuits. Real time storage and accelerated testing results were analyzed and integrated to develop a non-operating reliability prediction model. Failure mechanisms are also discussed in detail. This information is part of a research program being conducted by the U.S. Army Missile Command, Redstone Arsenal, Alabama. The objective of this program is the development of non-operating (storage) reliability prediction and assurance techniques for missile materiel. Author (GRA)

N77-15417# Raytheon Co., Huntsville, Ala. Dept. of Life Cycle Analysis.
STORAGE RELIABILITY OF MISSILE MATERIEL PROGRAM. STORAGE RELIABILITY SUMMARY REPORT. VOLUME 3: HYDRAULIC AND PNEUMATIC DEVICES Final Report, Jun. 1974 - Jun. 1976
Joe C. Mitchell May 1976 99 p refs
(Contract DAAH01-74-C-0853)
(AD-A026477; LC-76-2-Vol-3) Avail: NTIS HC A05/MF A01 CSCL 16/4

This summary documents findings on the non-operating reliability of valves, accumulators, actuators, pumps, cylinders, compressors, filters, gaskets and seals, bearings and regulators. The failure rates for each of the parts are given with one sided 90% confidence limits calculated. Elements of design are reviewed, and predominant failure modes and mechanisms are discussed. This information is part of a research program being conducted by the U.S. Army Missile Command, Redstone Arsenal, Alabama. The objective of this program is the development of non-operating (storage) reliability prediction and assurance techniques for missile materiel. GRA

N77-15418# Raytheon Co., Huntsville, Ala. Dept. of Life Cycle Analysis.
STORAGE RELIABILITY OF MISSILE MATERIEL PROGRAM. STORAGE RELIABILITY SUMMARY REPORT. VOLUME 4: ORDNANCE DEVICES Final Report, Jun. 1974 - Jun. 1976
Dennis F. Malik May 1976 67 p refs
(Contract DAAH01-74-C-0853)
(AD-A026478; LC-76-2-Vol-4) Avail: NTIS HC A04/MF A01 CSCL 16/4

This report summarizes analyses on the non-operating reliability of missile ordnance devices. The analyses are part of a research program being conducted by the U.S. Army Missile Command, Redstone Arsenal, Alabama. The objective of the program is the development of non-operating (storage) reliability prediction and assurance techniques for missile materiel. Included are analyses of solid propellant rocket motors, gas generators, igniters, safe and arm devices, and other explosive devices. Reliability models are developed for each component type. GRA

N77-15419# Raytheon Co., Huntsville, Ala. Dept. of Life Cycle Analysis.
STORAGE RELIABILITY OF MISSILE MATERIEL PROGRAM. MISSILE HYDRAULIC AND PNEUMATIC SYSTEMS ACCUMULATOR ANALYSIS Final Report, Jun. 1974 - Jun. 1976
Joe C. Mitchell May 1976 33 p refs
(Contract DAAH01-74-C-0853)
(AD-A026447; LC-76-HP2) Avail: NTIS HC A03/MF A01 CSCL 16/1

This report documents findings on the non-operating reliability of accumulators. The study consists of over 326 million part hours. The sources show an overall storage failure rate of 32.6 FITS (failures per billion hours) with a one sided 90% confidence

limit of 54.8 FITS for hydraulic accumulators. Elements of accumulator design are discussed. This information is part of a research program being conducted by the U.S. Army Missile Command, Redstone Arsenal, Alabama. The objective of this program is the development of non-operating (storage) reliability prediction and assurance techniques for missile materiel.
Author(GRA)

N77-15420# Raytheon Co., Huntsville, Ala. Dept. of Life Cycle Analysis.
STORAGE RELIABILITY OF MISSILE MATERIEL PROGRAM. MISSILE HYDRAULIC AND PNEUMATIC SYSTEMS VALVE ANALYSIS Final Report, Jun. 1974 - Jun. 1976
Joe C. Mitchell May 1976 72 p refs
(Contract DAAH01-74-C-0853)
(AD-A026448; LC-76-HP1) Avail: NTIS HC A04/MF A01 CSCL 16/1

This report documents findings on the non-operating reliability of hydraulic and pneumatic valves. Long term non-operating data has been analyzed, and failure rate predictions have been made. This report is a result of a program whose objective is the development of non-operating (storage) reliability prediction and assurance techniques for missile materiel. The analysis results will be used by U. S. Army personnel and contractors in evaluating current missile programs and in the design of future missile systems.
GRA

N77-15421# Raytheon Co., Huntsville, Ala. Dept. of Life Cycle Analysis.
STORAGE RELIABILITY OF MISSILE MATERIEL PROGRAM. MISSILE HYDRAULIC AND PNEUMATIC SYSTEMS PUMP ANALYSIS Final Report, Jun. 1974 - Jun. 1976
Joe C. Mitchell May 1976 55 p refs
(Contract DAAH01-74-C-0853)
(AD-A026449; LC-76-HP4) Avail: NTIS HC A04/MF A01 CSCL 16/1

This report documents findings on the non-operating reliability of pumps. The study consists of over 1.2 billion part hours. The sources show storage failure rate for Positive Displacement Pumps, Fixed and Variable, as 380.2 FITS (failures per billion hours) and 475.0 FITS respectively. It also gives failure rates for Kinetic, 200.0 FITS; Hydraulic, 95.3 FITS; and Fuel Pumps, 123.9 FITS. Elements of pump design are reviewed. This information is part of a research program being conducted by the U.S. Army Missile Command, Redstone Arsenal, Alabama. The objective of this program is the development of non-operating (storage) reliability prediction and assurance techniques for missile materiel.
Author (GRA)

N77-15422# Raytheon Co., Huntsville, Ala. Dept. of Life Cycle Analysis.
STORAGE RELIABILITY OF MISSILE MATERIEL PROGRAM. MISSILE HYDRAULIC AND PNEUMATIC SYSTEMS ACTUATOR ANALYSIS Final Report, Jun. 1974 - Jun. 1976
Joe C. Mitchell May 1976 33 p refs
(Contract DAAH01-74-C-0853)
(AD-A026353; LC-76-HP3) Avail: NTIS HC A03/MF A01 CSCL 16/1

This report documents findings on the non-operating reliability of hydraulic and pneumatic actuators. Long term non-operating data has been analyzed, and storage failure rate predictions have been made. This report is a result of a program whose objective is the development of non-operating (storage) reliability prediction and assurance techniques for missile materiel. The analysis results will be used by U.S. Army personnel and contractors in evaluating current missile programs and in the design of future missile systems.
GRA

N77-15423# Raytheon Co., Huntsville, Ala. Dept. of Life Cycle Analysis.
STORAGE RELIABILITY OF MISSILE MATERIEL PROGRAM: GYROSCOPE ANALYSIS Final Report, Jun. 1974 - Jun. 1976
R. E. Cordray May 1976 33 p refs
(Contract DAAH01-74-C-0853)
(AD-A026075; LC-76-EM1) Avail: NTIS HC A02/MF A01 CSCL 16/1

The report documents findings on the non-operating reliability of gyroscopes. Based on 825 million part-hours, the storage failure rate for gyroscopes is 348 FITS (failures per billion hours) with one sided 90% confidence limit at 412 FITS. Catastrophic failures are 55% of the total; spares usage is 3 times the failure rate. Elements of gyroscope construction are reviewed, and important factors for gyroscope storage reliability are identified. The objective of this program is the development of non-operating (storage) reliability prediction and assurance techniques for missile materiel.
GRA

N77-15424# Raytheon Co., Huntsville, Ala. Dept. of Life Cycle Analysis.
STORAGE RELIABILITY OF MISSILE MATERIEL PROGRAM: ACCELEROMETER ANALYSIS Final Report, Jun. 1974 - Jun. 1976
R. E. Cordray May 1976 18 p refs
(Contract DAAH01-74-C-0853)
(AD-A026076; LC-76-EM2) Avail: NTIS HC A02/MF A01 CSCL 16/1

The report documents findings on the non-operating reliability of accelerometers. A total of 352 million part hours were examined. The best storage failure rate for accelerometers is 25 FITS (failures per billion hours) with one sided 90% confidence level of 99 FITS. Construction principles are described and desirable storage conditions indicated. The objective of this program is the development of non-operating (storage) reliability prediction and assurance techniques for missile materiel. GRA

N77-15425# Raytheon Co., Huntsville, Ala. Dept. of Life Cycle Analysis.
STORAGE RELIABILITY OF MISSILE MATERIEL PROGRAM. STORAGE RELIABILITY ANALYSIS SUMMARY REPORT. VOLUME 1: ELECTRICAL AND ELECTRONIC DEVICES Final Report, Jun. 1974 - Jun. 1976
Dennis F. Malik May 1976 277 p refs 5 Vol.
(Contract DAAH01-74-C-0853)
(AD-A026275; LC-76-2-Vol-1) Avail: NTIS HC A13/MF A01 CSCL 16/1

The report summarizes analyses on the non-operating reliability of missile electrical and electronic devices. The objective of the program is the development of non-operating (storage) reliability prediction and assurance techniques for missile materiel. Included are analyses of integrated circuits, semiconductors, vacuum tubes, resistors, capacitors, inductive devices, crystals, batteries, connections, connectors and printed wiring boards.
GRA

N77-15426# Raytheon Co., Huntsville, Ala. Dept. of Life Cycle Analysis.
STORAGE RELIABILITY OF MISSILE MATERIEL PROGRAM. STORAGE RELIABILITY SUMMARY REPORT. VOLUME 2: ELECTROMECHANICAL DEVICES Final Report, Jun. 1974 - Jun. 1976
R. E. Cordray May 1976 84 p refs 5 Vol.
(Contract DAAH01-74-C-0853)
(AD-A026077; LC-76-2-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 16/1

The report contains the available information on storage failure rates for electromechanical devices, summarized from other reports on accelerometers, gyroscopes, relays, and switches. The objective of this program is the development of non-operating (storage) reliability prediction and assurance techniques for missile materiel.
GRA

N77-15427# Raytheon Co., Huntsville, Ala. Dept. of Life Cycle Analysis.
STORAGE RELIABILITY OF MISSILE MATERIEL PROGRAM: RELAY ANALYSIS Final Report, Jun. 1974 - Jun. 1976
R. E. Cordray May 1976 46 p refs
(Contract DAAH01-74-C-0853)
(AD-A026078; LC-76-EM3) Avail: NTIS HC A03/MF A01 CSCL 16/1

The report documents findings on the non-operating reliability of relays. The study covers 2,218 million part-hours. The best sources show a storage failure rate of 1.3 FITS (failures per billion hours) with a one sided 90% confidence limit of 5.0 FITS. Elements of relay design and of the processes at the contacts

are reviewed. The possibilities of solid state and saturable core alternatives are described. Recommendations include periodic test and inclusion of oxygen in the fill gas. The objective of this program is the development of non-operating (storage) reliability prediction and assurance techniques for missile materiel. GRA

N77-15428# Raytheon Co., Huntsville, Ala. Dept. of Life Cycle Analysis.
STORAGE RELIABILITY OF MISSILE MATERIEL PROGRAM: SWITCH ANALYSIS Final Report, Jun. 1974 - Jun. 1976
R. E. Cordray May 1976 22 p refs
(Contract DAAH01-74-C-0853)
(AD-A026079; LC-76-EM4) Avail: NTIS HC A02/MF A01 CSCL 16/1

The report documents findings on the non-operating reliability of switches. Of 473 million part-hours, the best data shows a storage failure rate of 54 FITS (failures per billion hours) with a one sided 90% confidence limit of 76 FITS. No statistically significant difference was found among the various switch types with respect to storage failure rate. Recommendations include care to avoid particulate contamination and inclusion of oxygen in the fill gas for enclosed designs. The objective of this program is the development of non-operating (storage) reliability prediction and assurance techniques for missile materiel. GRA

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

N77-15429 Rutgers Univ., New Brunswick, N.J.
THE DEFLECTION, CRACKING AND LIMIT STATE LOAD BEHAVIOR OF TWO WAY CONTINUOUS CONCRETE SLABS AND PLATES USING UNBONDED POST-TENSIONING Ph.D. Thesis
Pinaki Ranjan Chakrabarti 1976 333 p
Avail: Univ. Microfilms Order No. 76-26990

Theoretical analysis is made for deflection. A simplified method of deflection calculation is suggested, and the calculated values are compared with the measured values. Cracking behavior of the test specimens is studied. Theoretical analysis for the collapse load of the test specimen is made and the calculated values are compared with the measured values. Dissert. Abstr.

N77-15430 Wisconsin Univ., Madison.
FLEXURAL-TORSIONAL BUCKLING OF INTERSECTING INTER-CONNECTED BEAMS Ph.D. Thesis
Shitalkumar P. Morchi 1976 168 p
Avail: Univ. Microfilms Order No. 76-20911

Elastic flexural-torsional buckling of intersecting inter-connected beams is investigated. The basic governing differential equations, the equilibrium conditions at the joint and the natural boundary conditions for the buckled beam-cross are derived by using the calculus of variations. Different critical combinations of axial loads and transverse concentrated load at the joint and transverse uniform loads on the intersecting I-beams in a beam-cross are obtained. For the beam-crosses made up of rectangular beams and I-beams, the effect of the ratio of lengths of the two intersecting beams and the stiffnesses of the end restraints on the critical values of the transverse concentrated load at the joint is studied. The results are tabulated and represented graphically. Dissert. Abstr.

N77-15431 State Univ. of New York, Buffalo.
THE EFFECT OF PRESTRESS ON THE FLEXURAL MOTIONS OF PLATES Ph.D. Thesis
Joseph Padlog 1976 120 p
Avail: Univ. Microfilms Order No. 76-26553

The equations of flexural motions of isotropic, elastic plates which include shear and rotatory inertia effects are extended to include membrane type prestresses. Analytical solutions are obtained which yield the effects of prestress on the plate flexural dispersion relationships and the diffraction of straight-crested waves at the interface of two connected semi-infinite plates and at the boundary of a semi-infinite plate considering various boundary conditions. Results of a study of the effects of prestress on the energy flux distributions in plates is presented. In general, it is found that the effects of prestress on the wave motions in plates can be significant. Dissert. Abstr.

N77-15432 North Carolina State Univ., Raleigh.
BUCKLING OF BEAMS ON AN ELASTIC FOUNDATION Ph.D. Thesis
Donald Robert Hayes 1976 74 p
Avail: Univ. Microfilms Order No. 76-28485

The stability of an infinitely long beam of rectangular cross section subjected to an axial compressive force and bonded to an isotropic, elastic semi-infinite continuum is investigated. The stability problem is solved by a static analysis using both the Bernoulli-Euler beam theory and a more refined formulation that includes the effect of the transverse shearing stresses on the beam deflection. The effect of the elastic continuum is determined by solving the three dimensional equations of equilibrium in terms of displacements from the theory of elasticity. The stability solution obtained from the continuum analysis is then used to relate the coefficients in both a Wieghardt-type two parameter model and a Fletcher-Hermann three parameter model to the elastic constants of the foundation material. Dissert. Abstr.

N77-15433 North Carolina State Univ., Raleigh.
ANALYSIS OF HYPERBOLIC-PARABOLOID INVERTED UMBRELLA SHELLS WITH PRESTRESSED EDGE MEMBERS Ph.D. Thesis
Arobindo Dutt 1976 200 p
Avail: Univ. Microfilms Order No. 76-28473

The finite element method of structural analysis is employed for the analysis. The displacement functions used to represent the in-plane displacements of the shell middle surface are the usual plane stress functions. The normal displacement is represented by a compatible interpolation function originally proposed by Birkhoff and Garabedian. Complete rigid body mode is incorporated in the displacement functions to ensure completeness criterion. The various quantities of interest are represented in their natural coordinate system, that is surface coordinates. Dissert. Abstr.

N77-15434 Case Western Reserve Univ., Cleveland, Ohio.
THE PLASTIC BUCKLING OF A STEEL LINER ENCASED IN A CONCRETE CYLINDER Ph.D. Thesis
Young In Moon 1976 119 p
Avail: Univ. Microfilms Order No. 76-28401

Two different stress-strain diagrams of the material are employed for comparison. The initial imperfections are expressed in the same function of the deflection curve, and their effect is also included in the curves. As an extreme case, an idealized plastic hinge model is introduced to investigate the postbuckling behaviors and to obtain the relationship between the maximum deflection and the strain or the deflected angle. The results of the column analysis are used to introduce the effect of imperfections and plasticity into the analysis of elastic liner shells. Dissert. Abstr.

N77-15435 Rensselaer Polytechnic Inst., Troy, N.Y.
A GENERAL DAMAGE EQUATION FOR LOW CYCLE FATIGUE LIFE PREDICTION AT ELEVATED TEMPERATURE Ph.D. Thesis
Warren James Ostergren 1976 290 p
Avail: Univ. Microfilms Order No. 76-27203

A new method is developed for predicting the effect of hold time and frequency on elevated temperature fatigue life. This follows from a stress-strain damage function which is proposed as a new measure of fatigue damage. This damage function is extended to predicting the effect of hold time and frequency through a variation of Coffin's frequency modified approach. It is shown to have good success in correlating available strain controlled fatigue test results. Dissert. Abstr.

N77-15436 Engineering Sciences Data Unit, London (England).
GENERALISATION OF SMOOTH CONTINUOUS STRESS-STRAIN CURVES FOR METALLIC MATERIALS

Aug. 1976 12 p
(ESDU-76016; ISBN-0-85679-153-9) For information on availability of series, sub-series, and other individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161. HC $146.50

A generalized method is presented for representing the stress-strain curve of a material by means of two parameters, obtained from readily available test data, which enables account to be taken of the characteristics of materials beyond the linear region of the stress-strain curve. Compressive material test data is also provided. This is applied to aluminum, steel and titanium structural elements such as beams, plates, columns, ties, etc., in which the limit of proportionality of the material is exceeded. It is also applicable to any metallic material which exhibits a smooth continuous stress-strain curve under either tensile or compresssive loading. Author

N77-15437 City Univ. of New York.
DEEP BUCKLING OF A THIN OBLATE SPHEROIDAL SHELL UNDER UNIFORM NORMAL PRESSURE Ph.D. Thesis
Neal Henry Jacobs 1976 100 p
Avail: Univ. Microfilms Order No. 76-28887

Eric Reissner's equations for axisymmetrical deformations of thin shells of revolution are specialized to the case of deformation of a thin ellipsoidal shell under uniform normal pressure. The linked pair of nonlinear differential equations which results is solved approximately by the Bubnov-Galerkin method, producing the first complete description of an ellipsoidal shell under pressure. For an oblate ellipsoidal shell of revolution, 1 unit in radius at the equator, 1 unit tall from pole to pole, .02 units thick, made of a material for which Poisson's ratio is .3 and for which Young's modulus is E, the buckling pressure is determined to be 130 millionths of E, the collapse pressure to be 152 millionths of E, and the lower critical pressure to be 25 millionths of E. Dissert. Abstr.

N77-15438*# Douglas Aircraft Co., Inc., Long Beach, Calif.
BOLTED JOINTS IN GRAPHITE-EPOXY COMPOSITES
L. J. Hart-Smith Jun. 1976 156 p refs
(Contract NAS1-13172)
(NASA-CR-144899) Avail: NTIS HC A08/MF A01 CSCL 13M

All-graphite/epoxy laminates and hybrid graphite-glass/epoxy laminates were tested. The tests encompassed a range of geometries for each laminate pattern to cover the three basic failure modes - net section tension failure through the bolt hole, bearing and shearout. Static tensile and compressive loads were applied. A constant bolt diameter of 6.35 mm (0.25 in.) was used in the tests. The interaction of stress concentrations associated with multi-row bolted joints was investigated by testing single- and double-row bolted joints and open-hole specimens in tension. For tension loading, linear interaction was found to exist between the bearing stress reacted at a given bolt hole and the remaining tension stress running by that hole to be reacted elsewhere. The interaction under compressive loading was found to be non-linear. Comparative tests were run using single-lap bolted joints and double-lap joints with pin connection. Both of these joint types exhibited lower strengths than were demonstrated by the corresponding double-lap joints. The analysis methods developed here for single bolt joints are shown to be capable of predicting the behavior of multi-row joints. Author

N77-15439# Materials Research Labs., Maribyrnong (Australia).
AN EVALUATION OF THE RELIABILITY OF INSTRUMENTED CHARPY TEST RECORDS
R. C. Barnes Aug. 1976 19 p refs
(MRL-TN-384; AR-268) Avail: NTIS HC A02/MF A01

The shortcomings of various experimental techniques associated with the production of reliable instrumented Charpy test records are examined for the case of materials which show substantial ductility prior to fracture. A simple procedure for calibration and testing which avoids these problems and has direct relevance to fracture toughness properties is discussed. Author

N77-15440*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Science and Mechanics.
SOME INCONSISTENCIES OF THE FINITE ELEMENT METHOD AS APPLIED TO INELASTIC RESPONSE
Manohar P. Kamat and Douglas E. Killian Washington NASA Dec. 1976 32 p refs
(Grant NGR-47-004-114)
(NASA-CR-2732; Rept-313635-1) Avail: NTIS HC A03/MF A01 CSCL 13M

The inadequacy of a two noded beam-column element with a linear axial and a cubic transverse displacement field for inelastic analysis is demonstrated. For complete equilibrium satisfaction in the linear elastic range a three noded beam-column element is shown to be consistent. Next, the sensitivity of the inelastic response to numerical solutions of the inelastic response of a cantilever beam resulting from approximate integration of strain energy are brought out and finally, consequences of this on the nonlinear transient response of structures are considered. Author

N77-15441*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FREE-VIBRATION CHARACTERISTICS OF A LARGE SPLIT-BLANKET SOLAR ARRAY IN A 1-g FIELD
Francis J. Shaker Washington Dec. 1976 62 p refs
(NASA-TN-D-8376; E-8827) Avail: NTIS HC A04/MF A01 CSCL 13M

Two methods for studying the free vibration characteristics of a large split blanket solar array in both a 0-g and a 1-g cantilevered configuration are presented. The 0-g configuration corresponds to an in-orbit configuration of the array; the 1-g configuration is a typical ground test configuration. The first method applies the equations of continuum mechanics to determine the mode shapes and frequencies of the array; the second method uses the Rayleigh-Ritz approach. In the Rayleigh-Ritz method the array displacements are represented by string modes and cantilevered beam modes. The results of this investigation are summarized by a series of graphs illustrating the effects of various array parameters on the mode shapes and frequencies of the system. The results of the two methods are also compared in tabular form. Author

N77-15442*# Lockheed Missiles and Space Co., Huntsville, Ala.
STUDY LEADING TO THE REFINEMENT OF THE SRB STRUCTURAL ANALYSIS PROGRAM Final Report, 1 Dec. 1975 - 30 Nov. 1976
William E. Jones and Robert L. Edison Nov. 1976 96 p refs
(Contract NAS8-31750)
(NASA-CR-150140; LMSC-HREC-TR-D497054) Avail: NTIS HC A05/MF A01 CSCL 13M

The constructed SRB math model was used for the analysis of the 85/32/5(VV/VH/theta) cavity collapse load condition for the aft end of the SRB structure. Linear, nonlinear collapse and bifurcation buckling analyses were performed. The linear and bifurcation buckling analyses showed that structural integrity and positive margins of safety are maintained for the applied maximum load case using a design factor of 1.25. The nonlinear collapse analysis predicts stresses in the skirt above the yield for a load factor of 1.0. Applying the 1.25 design factor gives a negative margin of safety against the material ultimate. The predicted collapse occurs at a load factor higher than 1.25. Author

N77-15443# Sandia Labs., Albuquerque, N.Mex.
THERMAL STRESSES IN COMPOSITE FLYWHEELS
Robert C. Reuter, Jr. Apr. 1976 24 p ref
(Contract AT(29-1)-789)
(SAND-76-0183) Avail: NTIS HC A02/MF A01

Thermal stresses and displacements in anisotropic, thickwalled cylinders or disks due to uniform temperature changes are examined. Parameters are identified which, if properly chosen, can reduce thermal stresses. Application of this analysis to composite flywheels is discussed. ERA

N77-15444# Sandia Labs., Albuquerque, N.Mex.
RESISTANCE OF BONDED COMPOSITE JOINTS TO OUT-OF-PLANE FORCES
Ronald E. Allred and Tommy R. Guess Mar. 1976 30 p refs
(Contract AT(29-1)-789)
(SAND-75-0460) Avail: NTIS HC A03/MF A01

An analytical and experimental study was conducted to examine the mechanical behavior of double-lapped adhesive bonded joints subjected to bending loads. Adherends consisted

of a U-shaped high strength steel hub and a unidirectional composite of either B/Al or B/epoxy. Adhesives with a range of moduli and peel strengths were evaluated with and without bolts in regions of high stress concentration. Finite element analysis results indicated high shear and normal stress concentrations at the end of the steel hub legs. These concentrations are a direct function of the effective hub stiffness - increases in hub thickness or Young's modulus result in higher adhesive stresses. ERA

N77-15445# Sandia Labs., Albuquerque, N.Mex. Applied Mechanics Div.

EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF AN INTERLOCKING TAPE JOINT

Mike Huerta and Joe T. Black Mar. 1976 54 p refs
(Contract AT(29-1)-789)
(SAND-76-0166) Avail: NTIS HC A04/MF A01

An experimental study which utilized aluminum tape joint models loaded under different loading conditions is described. Experimental joint strengths, deformation modes, and failure characteristics are discussed. An analytical method of analyzing the joint by use of an axisymmetric finite element computer code is described. Results of the analytical method are presented and related to experimental observations. ERA

N77-15446# Watervliet Arsenal, N.Y.

DYNAMICS OF ELASTIC FOUNDATIONS AND CONSTRAINED BARS

G. L. Anderson May 1976 43 p refs
(DA Proj. 1F1-61102-AH-45)
(AD-A026404; WVT-TR-76021) Avail: NTIS HC A03/MF A01 CSCL 20/11

A variational principle is used to derive the equations of motion of a slender bar that has one lateral face clamped (or welded) onto a rigid surface. Correction factors for the transverse shear and normal strains are incorporated into the expression for the strain energy of the system. These factors are evaluated by requiring the lowest depth-shear and depth-stretch frequencies, as derived from the new approximate theory, to agree with the corresponding frequencies obtained from the full theory of generalized plane stress. The frequency equation for a simple supported constrained bar is derived, and plots of the variations of the natural frequencies of the transverse and longitudinal modes versus the length to depth ratio of the bar are presented.
Author (GRA)

N77-15447# Watervliet Arsenal, N.Y. Benet Weapons Lab.

PROPAGATION OF A CIRCULAR CRACK IN TORSION

Robert L. Ryan May 1976 30 p refs
(AD-A026533; WVT-TR-76017) Avail: NTIS HC A03/MF A01 CSCL 20/11

The propagation of a circular crack under dynamic torsional loading conditions is considered. The crack perimeter speed is taken to be an arbitrary monotonic increasing function of time. A general solution is obtained by means of integral transforms, together with Kostrov's technique; particular results are extracted for an initial value problem and for a suddenly appearing crack problem. The dynamic stresses near the periphery of the crack are found to have an inverse square root singularity. GRA

N77-15448# Watervliet Arsenal, N.Y. Benet Weapons Lab.

STRESS, STRAIN AND DEFLECTION IN CRACKED C-SHAPED SPECIMENS

R. Futczak and J. Throop Jul. 1976 46 p refs
(AD-A027192; WVT-TR-76025) Avail: NTIS HC A03/MF A01 CSCL 20/11

Experimental strains and load-line deflections of C-shaped fracture-toughness test specimens are reported as functions of load and increasing crack depth. It is shown that the variation in strain at the outer surface may be used as an indicator of fatigue crack growth for evaluating the critical load in fracture toughness tests. The stresses and load-line deflections are compared with theoretical values calculated for the uncracked specimens. Their relation to the stress intensity factor of the cracked specimen is examined. Author (GRA)

N77-15449# Lehigh Univ., Bethlehem, Pa. Center for the Application of Mathematics.

ON THE POSSIBLE VALUES OF THE STRAIN INVARIANTS FOR ISOCHORIC DEFORMATIONS

Kenneth N. Sawyers Jul. 1976 19 p refs
(Contract N00014-76-C-0235)
(AD-A027462; CAM-100-25) Avail: NTIS HC A02/MF A01 CSCL 20/11

A description is given of all possible values of the strain invariants (I sub 1) and (I sub 2) that may be attained in any experiment involving isochoric deformations. A graphical representation of the eigenvalues of the strain matrix is derived for any specified values of the invariants. GRA

N77-15450# Lehigh Univ., Bethlehem, Pa. Center for the Application of Mathematics.

THE FLEXURAL BIFURCATION CONDITION FOR A THIN PLATE UNDER THRUST

K. N. Sawyers and R. S. Rivlin Apr. 1976 10 p refs
(Contract N00014-67-C-0235)
(AD-A027461; CAM-100-24) Avail: NTIS HC A02/MF A01 CSCL 20/11

Previous results on the bifurcation condition for a thick elastic plate are specialized to the case where the aspect ratio (thickness/length) tends to zero. It is found that the bifurcation condition is independent of material constants up to terms of fourth order in the aspect ratio and depends on only one material constant up to terms of eighth order. GRA

N77-15451# RAND Corp., Santa Monica, Calif.

THEORY OF NORMAL MODES AND ULTRASONIC SPECTRAL ANALYSIS OF THE SCATTERING OF WAVES IN SOLIDS

Yih-Hsing Pao (Cornell Univ., Ithaca, N. Y.) and C. C. Mow Jan. 1976 48 p refs
(AD-A026674; R-1891-RC; MSC-2547) Avail: NTIS HC A03/MF A01 CSCL 20/1

Spectral analysis of ultrasonic pulses in elastic solids has attracted wide attention in recent years as a tool of the quantitative nondestructive test method. So far, a complete analysis of the power spectra of the scattered pulses of any geometry is still lacking. This has hindered the general understanding and the application of ultrasonic spectroscopy to the detection of inclusions of flaws in solids. This report presents a theory of the spectral analysis of the scattering of elastic waves and illustrates it with numerical results for the scattering by a circular cylindrical fluid inclusion in a solid. When the spectral frequencies are nearly equal to the real parts of the principal frequencies of the fluid inclusion in free vibration, the power spectrum of the scattered pulses undergoes a rapid rise and fall in magnitude because of the selective transmission of an incident wave. The conspicuous peaks and valleys of the backward and forward scattering spectra can be identified with the overtone frequencies of the two lowest normal modes of the cylinder, from which the characteristics of the fluid inclusion, the ratio of the wave speed to radius, can be determined. An application of spectral analysis to quantitative nondestructive testing of materials is discussed. Author (GRA)

N77-15452# Tel-Aviv Univ. (Israel). Dept. of Solid Mechanics, Materials and Structures.

VIBRATION ANALYSIS OF VISCOELASTIC BODIES WITH SMALL LOSS TANGENTS

Zvi Hashin Apr. 1976 22 p refs
(Grant AF-AFOSR-2591-74; AF Proj. 9782)
(AD-A027703; TAU-SOE-340/76; Scientific-4; AFOSR-76-0830TR) Avail: NTIS HC A02/MF A01 CSCL 20/11

The correspondence principle for vibrations of viscoelastic bodies is specialized to the case of small loss tangents, resulting in considerable simplification: analytical evaluation of oscillatory fields is greatly simplified; peak frequencies and peak amplitudes under forced vibrations can be simply and directly determined; numerical solution of viscoelastic vibration problems becomes no more complicated than that of elastic problems. Similar simplifications result for computation of real and imaginary parts of effective complex moduli of composite materials.
Author (GRA)

N77-15453# Arizona Univ., Tucson. Dept. of Aerospace and Mechanical Engineering.

APPLICATION OF GIFTS III TO STRUCTURAL ENGINEER-

ING PROBLEMS
H. A. Kamel and M. W. McCabe 22 Apr. 1976 55 p refs Presented at the George Washington Univ. 2d Natl. Symp. on Computerized Structural Analysis and Design, Washington, D. C., 29 Mar. 1976 Submitted for publication
(Contracts N00014-75-C-0837; DOT-CG-43565-A; NR Proj. 064-531)
(AD-A026616; TR-1) Avail: NTIS HC A04/MF A01 CSCL 20/11

The paper describes the latest version of the GIFTS SYSTEM (Graphics Oriented Interactive Finite Element Package for Time-Sharing), due for release at the end of March 1976. The paper gives a description of the program modules available in the GIFTS library and the options available within its framework. Examples are given to demonstrate the use of GIFTS in design-oriented applications. Some performance measurements are included. Amongst the GIFTS features described are: Automatic model and load generation; Generation and display of higher order elements; Display of model, loads, boundary conditions, deflections and stresses; Suitability for use as a pre- and post-processor for large batch programs; Static analysis capabilities for trusses, frames, membranes, plates and shells; Vibrational mode computation for complex structures; Transient response analysis using either direct integration or a model analysis approach; Substructuring and constrained substructuring; Mixed boundary conditions; and Thermal stress. Three examples have been chosen for inclusion in the paper. They illustrate some of the more important aspects of the GIFTS III system. These examples include the analysis of a three-dimensional framework, vibrational mode computation of an aircraft wing and the analysis, using substructures, of a bulk-ore carrier. GRA

N77-15454# Army Materials and Mechanics Research Center, Watertown, Mass.
COMPUTER ANALYSIS OF STRESS-STRAIN DATA: PROGRAM DESCRIPTION AND USER INSTRUCTIONS Final Report
Ralph P. Papirno Apr. 1976 29 p
(DA Proj. 1T1-62105-AH-84)
(AD-A026098; AMMRC-TR-76-12) Avail: NTIS HC A03/MF A01 CSCL 20/11

A program description is given for a computer program which fits analytical expressions to experimental stress-strain, tension, or compression data. For stress values up to approximately the 0.2% offset yield strength, the three parameters for the Ramberg-Osgood description are determined; for values in excess of the yield strength the two constants for a simple strain hardening power law are found. Other quantities which are also derived from the data include several yield strengths, plastic strain components, tangent moduli, and values of Poisson's ratio. Simple statistical calculations are also made to indicate to the user the goodness of fit of the analytical expressions to the experimental data. The three Ramberg-Osgood parameters, together with the two strain hardening parameters and the end point of the data need only be stored for a simple data bank of stress-strain properties, since with these parameters the engineering stress-strain curve can be reproduced. A sample of the output data is given. GRA

N77-15455# Brown Univ., Providence, R. I. Dept. of Engineering.
A SOLID MECHANICS APPROACH TO THE SOLUTION OF FLUID-SOLID VIBRATION PROBLEMS BY FINITE ELEMENTS
E. Paul Sorensen and Pedro V. Marcal (Marc Analysis Res. Corp., Palo Alto, Calif.) May 1976 31 p refs
(Contract N00014-67-A-0191-0007; NR Proj. 064-512)
(AD-A026881; TR-13) Avail: NTIS HC A03/MF A01 CSCL 20/11

A method is outlined for treating fluid-solid interaction vibration problems as a solid continuum by the finite element procedure. The current approach to problems of this kind is reviewed, together with the equations governing the current approach to the vibration problem of a solid structure alone. The type of finite element necessary to treat the fluid-solid problem as a solid continuum is then described, and results and comparisons with previous work are presented. Author (GRA)

N77-15456# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
ON THE FAILURE OF ELLIPTICITY OF THE EQUATIONS FOR FINITE ELASTOSTATIC PLANE STRAIN
James K. Knowles and Eli Sternberg May 1976 33 p refs
(Contract N00014-75-C-0196)
(AD-A027263; TR-34) Avail: NTIS HC A03/MF A01 CSCL 20/12

In this paper the authors establish necessary and sufficient conditions, in terms of the local principal stretches, for ordinary and strong ellipticity of the equations governing finite plane equilibrium deformations of a compressible hyperelastic solid. The material under consideration is assumed to be homogeneous and isotropic, but its strain-energy density is otherwise unrestricted. The authors also determine the directions of the characteristic curves appropriate to plane elastostatic deformations that are accompanied by a failure of ellipticity. GRA

N77-15457# Maryland Univ., College Park. Glenn L. Martin Inst. of Technology.
THE NUMERICAL INVERSION OF INTEGRAL TRANSFORMS WITH APPLICATIONS TO FLUID-VISCOELASTIC SOLID VIBRATION PROBLEMS Interim Technical Report
Bruce S. Berger and C. M. H. Dai May 1976 17 p refs
(Contract N00014-67-A-0239-0020)
(AD-A026951; Rept-1-76) Avail: NTIS HC A02/MF A01 CSCL 20/11

A technique is given, for the inversion of various integral transforms, which is based on the adaptive, quadratic, non-equidistant interpolation of the image function. The solution of the problem of the vibration of an infinite viscoelastic cylindrical shell, with and without a surrounding acoustic medium, demonstrates the techniques utility in connection with fluid-viscoelastic solid vibration problems. GRA

N77-15458# Pennsylvania State Univ., University Park. Materials Science Lab.
SHOCK ANALYSIS OF VISCOPLASTIC BEAMS Progress Report, 1 Jan. - 31 Dec. 1975
S. J. Yim and V. H. Neubert Dec. 1975 86 p refs
(Contract N00014-75-C-0759)
(AD-A027149; PR-1) Avail: NTIS HC A05/MF A01 CSCL 13/13

There are three reports under one cover. First is a theoretical study of the viscoplastic response at a beam cross-section based on a strain-rate sensitive constitutive equation with strain hardening. Time delay between peak moment and peak curvature is determined. The second deals with the effect of using various relationships between static moment and curvature. The third presents some preliminary results of a numerical solution for the base motion response of a viscoplastic beam with immovable hinged ends, considering combined tension and bending. GRA

N77-15459# Connecticut Dept. of Transportation, Wethersfield. Bureau of Planning and Research.
PERFORMANCE OF A CONTINUOUSLY REINFORCED CONCRETE OVERLAY IN CONNECTICUT. 1: CONSTRUCTION Interim Report
David G. Bowers Feb. 1976 42 p
(PB-257502/5; Rept-395-1-76-8; FHWA-RD-76-S0521) Avail: NTIS HC A03/MF A01 CSCL 13B

During the course of paving, leave-out sections were required to accommodate traffic. Special procedures to cool the pavement ends and reduce end movement were followed prior to and after placement of these sections. Data on initial crack frequencies are also presented. GRA

N77-15460# Pratt and Whitney Aircraft, East Hartford, Conn.
BOUNDARY-INTEGRAL EQUATION METHOD FOR ELASTIC FRACTURE MECHANICS ANALYSIS Interim Report, 1 Apr. 1975 - 31 Mar. 1976
T. A. Cruse, J. R. Osias, and R. B. Wilson May 1976 65 p refs
(Contract F44620-74-C-0060; AF Proj. 9782)
(AD-A027716; PWA-5406; AFOSR-76-0878TR) Avail: NTIS HC A04/MF A01 CSCL 11/6

A method has been developed and evaluated for merging two dimensional boundary-integral equation and finite element

stress analysis programs. A variational formulation has been obtained which provides an analytical basis for the study of different merging schemes. Extensive numerical results are presented which verify the applicability of the merged analyses to fracture mechanics problems. Numerical and experimental results are presented in the area of fatigue life prediction for gas turbine structures with surface or corner cracks to correlate previously developed three-dimensional fracture mechanics analysis methods. GRA

N77-15461# Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.

NONLINEAR INELASTIC DYNAMIC ANALYSIS WITH SOIL-FLEXIBILITY IN ROCKING

Alan L. Unemori and Robert V. Whitman Feb. 1976 223 p refs Repr. from Seismic Design Decision Analysis--25 Submitted for publication

(Grant NSF GI-27955)

(PB-256794/9; R76-13; NSF/RA-760193) Avail: NTIS HC A10/MF A01 CSCL 13M

The dynamic response of a building on a rigid foundation designed for earthquakes is compressed to the dynamic response of the same building on a nonlinear inelastic flexible foundation. A 17-story reinforced concrete shear wall apartment building was placed on each one of two limiting cases of clay soils. Foundation systems were designed for each soil profile according to existing codes, and moment-rotation relationships for each foundation system were generated. An existing dynamic response computer program was modified to incorporate the predicted moment rotation characteristics of the foundations. Responses of the building on both flexible foundation systems were compared to the response of that building on a rigid foundation, and significant differences identified. GRA

N77-15462# Naval Research Lab., Washington, D.C. Engineering Materials Div.

DYNAMIC FRACTURE-RESISTANCE TESTING AND METHODS FOR STRUCTURAL ANALYSIS Final Report

E. A. Lange 27 Apr. 1976 28 p refs

(NRL Proj. M01-25; RR0220146)

(AD-A026983; NRL-7979) Avail: NTIS HC A03/MF A01 CSCL 11/6

The fracture properties of structural steels are sensitive to strain rate; this characteristic is responsible for most catastrophic failures of structures in these materials. The potential for the initiation of fast fracture can be predicted by the recently developed technology of linear elastic fracture mechanics (LEFM) which has provided the basis for an analytical approach to fracture resistance and structural integrity. Unfortunately, for routine engineering design use, the basic material parameter for plane-strain fracture toughness is either impossible or too expensive to obtain by direct measurement. Therefore, to make fracture mechanics a viable engineering design tool, empirical correlations between practical dynamic test results and the basic parameters are needed. The attributes and limitations of the Charpy, Drop Wright-Nil Ductility Transition Temperature, Drop Weight Tear, and Dynamic Tear tests are discussed with respect to providing information useful in structural integrity analyses. Author (GRA)

N77-15463# Virginia Highway and Transportation Research Council, Charlottesville.

DEVELOPMENT OF TEST PROCEDURE FOR THE DESIGN OF BLACK BASE Final Report

G. W. Maupin, Jr. Jun. 1976 24 p refs Sponsored in part by Univ. of Va. Prepared in cooperation with FHA, Washington, D. C.

(PB-257618/9; VHTRC-76-R62; FHWA-RD/M-0321) Avail: NTIS HC A02/MF A01 CSCL 13C

Stability testing equipment similar to that used in the design of surface mixes and the development of a compaction procedure for 6 inch (152.4 mm) diameter specimens are described. A compaction procedure was developed that could be used with slight modification to duplicate field densities. The trends of the VTM(Voids in Total Mix) and VFA(Voids Filled with Asphalt) curves appear promising as an indicator of the proper asphalt content; however, the inherent variability of the stability measurement eliminates it as a design criterion. GRA

N77-15464# Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.

DYNAMIC MODELING OF LARGE PRECAST PANEL BUILDINGS USING FINITE ELEMENTS WITH SUBSTRUCTURING Research Report, Sep. 1975 - Aug. 1976

Robert Alan Frank, James M. Becker, and John M. Biggs Aug. 1976 166 p refs Repr. from Seismic Resistance of Precast Concrete Panel Buildings, no. 2 Submitted for publication

(Grant NSF ENV-75-03778)

(PB-257220/4; MIT-CE-R76-36) Avail: NTIS HC A08/MF A01 CSCL 13C

The structure is assumed to respond elastically and is modeled using statically condensed super elements to represent the panels and anisotropic finite elements to model the connections. A typical building system is defined and the sensitivity of the dynamic response to several parameters examined. These parameters include the height of the structure, the width of the panel, the relative stiffness of the connection, the percent critical damping, and the variability in the expected ground motion. It was determined that the linear dynamic response of LPPB systems is similar to that of a shear wall structure. Response was found to be primarily in the first mode for shorter structures, while for taller structures the higher modes became important. GRA

N77-15465# Purdue Univ., Lafayette, Ind.

DESIGN AND CONSTRUCTION OF SEVERAL MAINTENANCE TECHNIQUES FOR CONTINUOUSLY REINFORCED CONCRETE PAVEMENTS Interim Report, 1 Jul. - 31 Dec. 1975

Robert H. Florence, Jr. Mar. 1976 168 p refs Sponsored by the Ind. State Highway Commission and the Federal Highway Admin.

(PB-257535/5; JHRP-76-12; FHWA-RD-76-S0522) Avail: NTIS HC A08/MF A01 CSCL 13B

A considerable amount of CRC pavements in Indiana have shown some distress. The design and construction of several maintenance techniques for CRC pavements were covered. A section of pavement on I-65 was stratified into similar sections of pavement using deflection, cracking, and breakups as the selection criteria. Various types of maintenance were applied to these sections in the summer and early fall of 1975. GRA

N77-15466# Naval Postgraduate School, Monterey, Calif.

STRUCTURAL RESPONSE OF FLUID CONTAINING TANKS TO PENETRATING PROJECTILES (HYDRAULIC RAM): A COMPARISON OF EXPERIMENTAL AND ANALYTICAL RESULTS Final Report, 1 Jul. 1974 - 30 Jun. 1976

R. E. Ball May 1976 109 p refs

(AD-A026320; NPS-57BP76051) Avail: NTIS HC A06/MF A01 CSCL 20/4

This report presents the results of a study of (1) the fluid hydraulic ram pressures in a fluid-containing-tank caused by a penetrating projectile, and (2) the transient response of the entry and exit walls of the tank due to the fluid pressure. The experimental and analytical hydraulic ram and structural response programs at the Naval Weapons Center (NWC) and the Naval Postgraduate School (NPS) are briefly described. The computer analyses for the fluid pressure at the entry and exit walls and the transient entry and exit wall strains are described in detail. Comparisons are made of the predicted wall strains with the circular entry wall strains, measured at NPS, and the square exit wall strains, measured at NWC. Good agreement in the form of the strain histories is obtained, but the magnitudes of the predicted strains are smaller than those of the measured strains. This study contributes to the knowledge of the hydraulic ram phenomenon and associated fluid-structure interaction, and should provide some useful information for the design of aircraft fuel tanks. Author (GRA)

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography*.

N77-15467*+ National Aeronautics and Space Administration, Washington, D.C.

EARTH RESOURCES: A CONTINUING BIBLIOGRAPHY WITH INDEXES, ISSUE 10, AUGUST 1976

Aug. 1976 226 p

(NASA-SP-7041(10)) Avail: NTIS HC E05 CSCL 05B

This bibliography lists 506 reports, articles, and other documents introduced into the NASA scientific and technical information system between April 1976 and June 1976. Emphasis is placed on the use of remote sensing and geophysical instrumentation in spacecraft and aircraft to survey and inventory natural resources and urban areas. Subject matter is grouped according to agriculture and forestry, environmental changes and cultural resources, geodesy and cartography, geology and mineral resources, hydrology and water management, data processing and distribution systems, instrumentation and sensors, and economic analysis. Author

N77-15468 California Univ., Davis.

PREDICTION OF NATURAL TEMPERATURES IN RIVERS Ph.D. Thesis

Richard Daniel Noble 1976 239 p

Avail: Univ. Microfilms Order No. 76-28987

Synoptic meteorological, flow, and water temperature data were collected over a three month period in the Mattole River basin in northern California. The meteorological variables monitored were total incoming radiation, incoming short wave radiation, wet bulb air temperature, dry-bulb air temperature, and wind velocity. Flow data included volumetric flow rate, time of travel, and axial dispersion coefficients. A mathematical model was developed for predicting the water temperature of a river at any point in the basin. The model includes convective and dispersive effects as well as a source term. Results indicate that calculated water temperatures can be obtained which have a daily root-mean-square deviation of less than 3 C, a daily amplitude ratio of plus or minus 0.20 of 1.0, and a daily mean within 2 C of observed data. Dissert. Abstr.

N77-15469 Minnesota Univ., Minneapolis.

A STOCHASTIC APPROACH TO SNOWMELT RUNOFF FORECASTING Ph.D. Thesis

Kwonshik Kim 1976 153 p

Avail: Univ. Microfilms Order No. 76-27863

Models were developed by which air temperature and precipitation data can be generated for spring periods so that the data can be used in mathematical runoff models to determine the range and probability of snowmelt floods. Historical data on temperature and precipitation in the Minnesota River Basin were studied to develop stochastic simulation models. The streamflow synthesis and reservoir regulation (SSARR) model was chosen as a transformation function. Temperature at one station could be modeled by a series of steps. Temperature was first transformed to obtain constant variance. Then the transformed temperature was divided into deterministic and stochastic components. The deterministic component was represented by a second degree regression line and the stochastic component was described by a first order autoregressive-first order moving average model. Dissert. Abstr.

N77-15470*# Transemantics, Inc., Washington, D.C.

LATIN AMERICAN COURSE ON REMOTE SENSORS

NASA Dec. 1976 14 p Transl. into ENGLISH of "Curso Latinoamericano de Sensores Remotos", Comision Nacl. de Invest. Espaciales, Buenos Aires, 1976 11 p

(Contract NASw-2792)

(NASA-TT-F-16218) Avail: NTIS HC A02/MF A02 CSCL 14B

Visual interpretation of information obtained by remote sensors for use in studies on natural resources is studied. Particular emphasis is given to fields of agriculture, forestation and geology. Both practical and theoretical classes, class work and field work are included. LANDSAT images selected for interpretation involve the Parana River delta and the Province of San Luis. Author

N77-15471*# Draper (Charles Stark) Lab., Inc., Cambridge, Mass.

ADVANCED EARTH OBSERVATION SYSTEM INSTRUMENTATION STUDY (AEOSIS) Final Report, 1 Dec. 1974 - 31 Dec. 1975

Robert E. Var Jun. 1976 141 p refs

(Contract NAS5-21917)

(NASA-CR-144839; R-963) Avail: NTIS HC A07/MF A01 CSCL 14B

The feasibility, practicality, and cost are investigated for establishing a national system or grid of artificial landmarks suitable for automated (near real time) recognition in the multispectral scanner imagery data from an earth observation satellite (EOS). The intended use of such landmarks, for orbit determination and improved mapping accuracy is reviewed. The desirability of using xenon searchlight landmarks for this purpose is explored theoretically and by means of experimental results obtained with LANDSAT 1 and LANDSAT 2. These results are used, in conjunction with the demonstrated efficiency of an automated detection scheme, to determine the size and cost of a xenon searchlight that would be suitable for an EOS Searchlight Landmark Station (SLS), and to facilitate the development of a conceptual design for an automated and environmentally protected EOS SLS. Author

N77-15472*# Mississippi Air and Water Pollution Control Commission, Jackson.

INVESTIGATION OF PEARL RIVER DATA COLLECTION SYSTEM Final Report

Nov. 1976 38 p

(Contract NAS8-31351)

(NASA-CR-150138) Avail: NTIS HC A03/MF A01 CSCL 08H

The reliability of employing NASA developed remote sensing for in situ near real time monitoring of water quality in the Pearl River is evaluated. The placement, operation and maintenance of a number of NASA developed data collection platforms (DCP's) on the Pearl River are described. The reception, processing, and retransmission of water quality data from an ERTS satellite to the Mississippi Air and Water Pollution Control Commission (MAWPCC) via computer linkup are assessed. Author

N77-15473*# Alabama Univ., University. Dept. of Chemical and Metallurgical Engineering.

WATER RESOURCES PLANNING FOR RIVERS DRAINING INTO MOBILE BAY Final Report

Gary C. April Dec. 1976 132 p refs

(Contract NAS8-29100)

(NASA-CR-150149; BER-209-112) Avail: NTIS HC A07/MF A01 CSCL 08H

The application of remote sensing, automatic data processing, modeling and other aerospace related technologies to hydrological engineering and water resource management are discussed for the entire river drainage system which feeds the Mobile Bay estuary. The adaptation and implementation of existing mathematical modeling methods are investigated for the purpose of describing the behavior of Mobile Bay. Of particular importance are the interactions that system variables such as river flow rate, wind direction and speed, and tidal state have on the water movement and quality within the bay system. Author

N77-15474# Hawaii Univ., Honolulu.

DEVELOPMENT OF THE UNIVERSITY OF HAWAII-MANOA STREAM GAGING STATION Project Completion Report, 1 Dec. 1974 - 31 Mar. 1976

Yu-Si Fok and Reginald H. F. Young May 1976 25 p refs

(Contract DI-14-31-0001-5011; OWRT Proj. A-056-HI(1))

(PB-257061/2; W76-11876; TMR-48) Avail: NTIS HC A02/MF A01 CSCL 08H

A permanent stream gaging station was established at a downstream location. The development, instrumentation, method of operation, and maintenance of this gaging station are reported. Data obtained from this new University of Hawaii-Manoa Stream Gaging Station will allow meaningful measurements of

streamflow and water quality characteristics of Manoa Stream.
GRA

N77-15475# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
APPLICATION OF REMOTE SENSING TO ENVIRONMENTAL MANAGEMENT AT MILITARY FACILITIES
Lewis E. Link, Jr. and Daniel H. Cress 1976 15 p refs
(AD-A026063) Avail: NTIS HC A02/MF A01 CSCL 14/5

The systematic application of remote sensing techniques at Fort Carson has provided critical information for the environmental management of vehicle-maneuver training areas. The remote sensing simulation model provided a quantitative means for selecting the best film-filter combination for the job. Only one type of information was extracted from remotely sensed data for the purposes of this example; the techniques and systematic procedures followed herein could easily be applied to more complex studies requiring other types of information. It must be emphasized that the application of remote sensing to a specific problem must be closely allied with the specific data requirements necessary for the solution of the problem. Accuracy, scale, and threshold values considered critical for detection must be identified prior to the conduct of the remote sensing mission to allow adequate planning of the data acquisition program, both on the ground and with remote sensor systems. Author (GRA)

N77-15476# National Academy of Sciences - National Research Council, Washington, D.C.
EDUCATION IN HYDROLOGY AND WATER RESOURCES IN THE UNITED STATES, 1965-1974: AN OVERVIEW WITH RECOMMENDATIONS Final Report
1976 84 p refs
(Contract NSF C-310)
(PB-257915/9) Avail: NTIS HC A05/MF A01 CSCL 05I

Conditions of education in hydrology and water resources in the United States for the period 1965-1974 are discussed, and future directions for education in these fields at university, pre-university, and continuing education levels are suggested. Some specific activities to assist education abroad are suggested, and periodic educational and manpower assessments are recommended. An overview committee concerned with education in water related fields, additional financial assistance for such education, a hydrology-centered office in the National Science Foundation and an independent water institute to act as a clearinghouse for hydrological and water resources education and information are recommended. GRA

N77-15477# Naval Postgraduate School, Monterey, Calif.
TACTICAL ELECTRONIC RECONNAISSANCE PROCESSING AND EVALUATION SEGMENT, A NEW LOOK M.S. Thesis
Daniel Patrick Kollay and Kenneth Lee Kreutzer Jun. 1976 99 p refs
(AD-A027248) Avail: NTIS HC A05/MF A01 CSCL 15/4

With the proposed procurement of EA-6B aircraft, the U.S. Marine Corps planned the development of TERPES (Tactical Electronic Reconnaissance Processing and Evaluation Segment) to perform post-mission tape analysis. The development phase was initiated on a first generation tactical computer, CP-642B. The thrust of this paper was to identify state-of-the-art replacements for the CP-642B, while identifying areas of concern within the development cycle. Alternative systems were discussed with the emphasis on system flexibility and expandability.
Author (GRA)

N77-15478# Utah Univ., Salt Lake City. Dept. of Meteorology.
REMOTE SENSING OF CIRRUS CLOUD COMPOSITIONS FROM SATELLITES Interim Report
Kuo-Nan Liou and Thomas Stoffel 9 Feb. 1976 83 p refs
(Contract F19628-75-C-0107; AF Proj. 627A)
(AD-A026512; Scientific-1; AFGL-TR-76-0027) Avail: NTIS HC A05/MF A01 CSCL 17/5

Comprehensive description of the discrete-ordinate method for the transfer of infrared radiation in an isothermal cloud layer is presented. Applications of such a method to non-isothermal, inhomogeneous atmospheres containing cirrus clouds are carried out, and a listing of the computational code of the infrared radiation program is given in the Appendix of this report. On the basis of this radiation program which allows non-isothermal as well as non-homogeneous structures of clouds, radiative properties of cirrus clouds are investigated in the 10 micrometers window region. Effects of non-isothermal structure of cirrus are shown to be important when its thickness is greater than about 3 km. In addition, we also find that it seems inappropriate to define an 'emissivity' of a non-isothermal cloud. Utilizing the concept of transmissivity derived from radiative transfer analyses, a retrieval technique is developed for the determination of the surface temperature, the cirrus cloud thickness and its transmissivity at a reference wavenumber and the fraction of cirrus cloudiness. Error analyses employing climatological data reveal that independent random errors in temperature and humidity profiles introduce insignificant errors in the four resulting parameters. Based on the retrieval procedures, we illustrate that the vertical ice content may be estimated assuming that ice particles are randomly oriented in a horizontal plane.
Author (GRA)

N77-15479# California Univ., Los Angeles. Dept. of Engineering Systems.
OPTIMIZATION OF REAL TIME DAILY OPERATION OF A MULTIPLE RESERVOIR SYSTEM
Willima W.-G. Yeh, Leonard Becker, D. Fults, D. Sparks, and G. Logan Apr. 1976 176 p refs
(Contract DI-14-31-0001-4208)
(PB-257515/7; UCLA-ENG-7628; W76-12155; OWRT-C-5184(4208)(4)) Avail: NTIS HC A09/MF A01 CSCL 13B

System optimizing procedures are developed for on-line use in the operation of the Central Valley Project (CVP) in California. The CVP is a complex multiple objective water resource system. The operation of the project is subject to requirements and interagency agreements which typify the usual water resource environment and which constrain optimal operating policy. The method developed for the CVP provides the necessary decomposition and involves the project manager, assisted by an integrated group of multiple policies based on inter-related monthly and daily models. GRA

N77-15480# West Virginia Univ., Morgantown. Plant Sciences Div.
EXTENSIVE OVERBURDEN POTENTIALS FOR SOIL AND WATER QUALITY Final Report, 1 Nov. 1973 - 1 Apr. 1975
Richard M. Smith, Andrew A. Sobek, Thomas Arkle, Jr., John C. Sencindiver, and John R. Freeman Aug. 1976 329 p refs Prepared in cooperation with Geol. and Econ. Surv., Morgantown, West Va.
(Grant EPA-R-802603-01)
(PB-257739/3; EPA-600/2-76-184) Avail: NTIS HC A15/MF A01 CSCL 08I

Chemical, physical and mineralogical measurements and interpretations developed were improved and applied to coal overburden columns in 12 widely spaced neighborhoods and 2 adjunct locations in 10 states, from Pennsylvania on the Northeast to Alabama on the southeast and Oklahoma on the west. Field studies in each neighborhood and adjunct location involved logging and sampling soil and rock horizons from surface to coal, testing and improving field clues, determining properties of mine soils and water resulting from mining operations, and checking reclamation. GRA

N77-15481# Cincinnati Univ., Ohio. Water Resources Div.
URBAN RUNOFF CHARACTERISTICS. VOLUME 1: ANALYTICAL STUDIES Final Report
Herbert C. Preul and C. N. Papadakis Sep. 1976 353 p refs Sponsored by EPA 2 Vol.
(PB-258033/0; EPA-600/2-76-217-a-Vol-1) Avail: NTIS HC A16/MF A01; also available in set of 2 reports as PB-258032-SET, PC $28.25/MF $5.00

Analytical studies and field investigations made for the characterization of urban runoff and combined sewer overflows. The analysis and development of stormwater management models was considered. The results of studies are given on the development of storm hyetographs and the determination of infiltration capacity curves for use in hydrologic runoff models. An hydrologic model known as the University of Cincinnati urban

runoff model was developed and a general description was given of the EPA storm water management model. GRA

N77-15482# Cincinnati Univ., Ohio. Water Resources Div.
URBAN RUNOFF CHARACTERISTICS. VOLUME 2: FIELD INVESTIGATIONS Final Report
Herbert C. Preul and C. N. Papadakis Sep. 1976 781 p
Sponsored by EPA 2 Vol.
(PB-258034/8; EPA-600/2-76-217-b-Vol-2) Avail: NTIS HC A99/MF A01; also available in set of 2 reports as PB-258032-SET, PC $28.25/MF $5.00 CSCL 08H

Analytical studies and field investigations for the characterization of urban runoff and combined sewer overflows are presented. A compilation is given of hydrologic and water quality data collected over a three year period from a typical combined sewer watershed of 2380 acres area in Cincinnati, Ohio. GRA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

N77-15483 Minnesota Univ., Minneapolis.
MULTIDIMENSIONAL CONDUCTION PHASE CHANGE WITH DENSITY CHANGE, AND APPLICATION TO THERMAL ENERGY STORAGE Ph.D. Thesis
Nagaraja Shamsundar 1976 257 p
Avail: Univ. Microfilms Order No. 76-27833

The enthalpy model for phase change at a sharply defined temperature was extended to more than one dimension and incorporated into a numerical solution method for treating problems with and without accompanying density change. In the model, enthalpy was treated as a dependent variable in addition to temperature, and the relation between enthalpy and temperature was used together with the conservation equations. The enthalpy model lead to a single integral equation which represented energy conservation in single-phase as well as two-phase regions. The equivalence between the enthalpy model and the conventional temperature based model was proved under very general circumstances for substances which have a sharply defined phase change temperature as well as for substances which undergo phase change over a range of temperatures. Discontinuous density change across phase boundaries and liquid motion were accounted for. Dissert. Abstr.

N77-15484 Arizona Univ., Tucson.
THE OPTICAL PROPERTIES OF CHROMIUM OXIDE FILMS AND THE HIGH TEMPERATURE STABILIZATION OF SILVER FILMS FOR PHOTOTHERMAL SOLAR ENERGY CONVERSION Ph.D. Thesis
Robert Edward Hahn 1976 235 p
Avail: Univ. Microfilms Order No. 76-28196

The structure and optical properties of reactively evaporated chromium oxide films and of the stabilization of thin silver films against agglomeration at elevated temperatures were investigated. The importance of these investigations lies in the extension of thin film technology to the fabrication of spectrally selective surfaces for efficient absorption and retention of incident flux in photothermal solar energy conversion. A series of chromium oxide films were deposited by the reactive evaporation of chromium in air or oxygen bleeds. The agglomeration of thin silver films on Pyrex and stainless steel substrates was studied and techniques were examined to prevent or control the phenomenon during the chemical vapor deposition of silicon-pn-silver coatings for photothermal conversion. Dissert. Abstr.

N77-15485 Wisconsin Univ., Madison.
A DESIGN PROCEDURE FOR SOLAR HEATING SYSTEMS Ph.D. Thesis
Sanford Alan Klein 1976 350 p
Avail: Univ. Microfilms Order No. 76-20673

A general transient system computer simulation program, TRNSYS, and 'f-charts', which form the basis of a general design procedure for solar heating systems were developed. The important dimensionless variables of solar heating systems are identified and simulations are used to develop a correlation between these variables and long-term system performance. The correlation, presented in both analytic and graphical form, is referred to as an 'f-chart'. The result is a simple method requiring monthly average meteorological data which can be used to estimate the long-term thermal performance of solar heating systems as a function of the major system design parameters. Combined with costs and meteorological data for the location in question, the f-chart provides a method to determine the economically optimum solar heating system design. Dissert. Abstr.

N77-15486*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SATELLITE POWER SYSTEM: ENGINEERING AND ECONOMIC ANALYSIS SUMMARY
Nov. 1976 282 p refs
(NASA-TM-X-73344) Avail: NTIS HC A13/MF A01 CSCL 10A

A system engineering and economic analysis was conducted to establish typical reference baselines for the photovoltaic, solar thermal, and nuclear satellite power systems. Tentative conclusions indicate that feasibility and economic viability are characteristic of the Satellite Power System. Anticipated technology related to manufacturing, construction, and maintenance operations is described. Fuel consumption, environmental effects, and orbital transfer are investigated. Space shuttles, local space transportation, and the heavy lift launch vehicle required are also discussed. Author

N77-15487*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE CORRELATIONS OF FIVE SOLAR COLLECTORS TESTED SIMULTANEOUSLY OUTDOORS
Dean R. Miller 1976 26 p Presented at the Joint Conf. of the Intern. Solar Energy Soc. and the Solar Energy Soc. of Canada, Winnipeg, Canada, 15-20 Aug. 1976
(NASA-TM-X-73546; E-8982) Avail: NTIS HC A03/MF A01 CSCL 10A

Collector thermal efficiency, and efficiency degradation with time were measured for 5 flat-plate solar collectors tested simultaneously in an outdoor solar collector test facility. Results indicate that by using collector performance parameters which account for diffuse isolation, outdoor data recorded on cloud days can be used as a measure of performance, as long as the ratio of direct to total insolation exceeds approximately 0.6. These outdoor results also show good agreement with thermal efficiency data obtained indoors in a solar simulator. Significant efficiency degradation occurred on only one of the five collectors exposed to outdoor conditions for a period of one to two years. Author

N77-15488*# Spectrolab, Inc., Sylmar, Calif.
A PROGRAM CONTINUATION TO DEVELOP PROCESSING PROCEDURES FOR ADVANCED SILICON SOLAR CELLS
J. E. Avery and J. A. Scott-Monck Nov. 1976 43 p refs
(Contract NAS3-17350)
(NASA-CR-135114) Avail: NTIS HC A03/MF A01 CSCL 10A

Shallow junctions, aluminum back surface fields and tantalum pentoxide (Ta205) antireflection coatings coupled with the development of a chromium-palladium-silver contact system, were used to produce a 2 x 4 cm wraparound contact silicon solar cell. One thousand cells were successfully fabricated using batch processing techniques. These cells were 0.020 mm thick, with the majority (800) made from nominal ten ohm-cm silicon and the remainder from nominal 30 ohm-cm material. Unfiltered, these cells delivered a minimum AMO efficiency at 25 C of 11.5 percent and successfully passed all the normal in-process and acceptance tests required for space flight cells. Author

N77-15489*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A PERFORMANCE EVALUATION OF VARIOUS COATINGS, SUBSTRATE MATERIALS, AND SOLAR COLLECTOR SYSTEMS
F. J. Dolan Sep. 1976 85 p refs
(NASA-TM-X-73355) Avail: NTIS HC A05/MF A01 CSCL 10A

An experimental apparatus was constructed and utilized in conjunction with both a solar simulator and actual sunlight to test and evaluate various solar panel coatings, panel designs, and scaled-down collector subsystems. Data were taken by an automatic digital data acquisition system and reduced and printed by a computer system. The solar collector test setup, data acquisition system, and data reduction and printout systems were considered to have operated very satisfactorily. Test data indicated that there is a practical or useful limit in scaling down beyond which scaled-down testing cannot produce results comparable to results of larger scale tests. Test data are presented as are schematics and pictures of test equipment and test hardware. Author

N77-15490*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ENCAPSULATED SOLAR CELL MODULES Patent Application
Evelyn Anagnostou and Americo F. Forestieri, inventors (to NASA) Filed 30 Nov. 1976 9 p
(NASA-Case-LEW-12185-1; US-Patent-Appl-SN-746269) Avail: NTIS HC A02/MF A01 CSCL 10A

A procedure is described in which the electrical connections to solar cells in a module are made at the same time the cells are encapsulated for protection. The encapsulating material is embossed to facilitate the positioning of the cells during assembly. NASA

N77-15491*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RESULTS FROM THE IMP-J VIOLET SOLAR CELL EXPERIMENT AND VIOLET CELL BALLOON FLIGHTS
Edward M. Gaddy Washington Dec. 1976 9 p refs
(NASA-TN-D-8393; G-7702F4) Avail: NTIS HC A02/MF A01 CSCL 10A

The Interplanetary Monitoring Platform-J violet solar cell experiment was flown in an orbit with mild thermal cycling and low hard-particle radiation. The results of the experiment show that violet cells degrade at about the same rate as conventional cells in such an orbit. Balloon flight measurements show that violet solar cells produce approximately 20% more power than conventional cells. Author

N77-15492*# Spectrolab, Inc., Sylmar, Calif.
DEMONSTRATION OF THE FEASIBILITY OF AUTOMATED SILICON SOLAR CELL FABRICATION Final Report
J. Thornhill and W. E. Taylor Aug. 1976 54 p
(Contract NAS3-18566)
(NASA-CR-135095; Rept-3884-FR) Avail: NTIS HC A04/MF A01 CSCL 10A

An analysis of estimated costs indicate that for an annual output of 4,747,000 hexagonal cells (38 mm. on a side) a total factory cost of $0.866 per cell could be achieved. For cells with 14% efficiency at AMO intensity (1353 watts per square meter), this annual production rate is equivalent to 3,373 kilowatts and a manufacturing cost of $1.22 per watt of electrical output. A laboratory model of such a facility was operated to produce a series of demonstration runs, producing hexagonal cells, 2 x 2 cm cells and 2 x 4 cm cells. Author

N77-15493*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
ILLUMINATION CONTROL APPARATUS FOR COMPENSATING SOLAR LIGHT Patent Application
Lester J. Owens, inventor (to NASA) Filed 23 Dec. 1976 20 p
(NASA-Case-KSC-11010-1; US-Patent-Appl-SN-753977) Avail: NTIS HC A02/MF A01 CSCL 10A

An illumination control apparatus for supplementing light from solar radiation with light from an artificial light source was designed to compensate for periods of insufficient levels of solar light to maintain a desired illumination level within an interior space. The apparatus comprises an artificial light source connected to an electrical power source, a switch for selectively energizing the light source, and an actuator for controlling the on-off operation of the switch. A light sensor is connected to the actuator to control it in response to the illumination level of the interior space. A limit switch is carried adjacent to actuator to limit the movement of the actuator within a predetermined range. This prevents further movement during detection of erroneous illumination conditions. NASA

N77-15494*# ECON, Inc., Princeton, N.J.
SPACE-BASED SOLAR POWER CONVERSION AND DELIVERY SYSTEMS STUDY. VOLUME 1: EXECUTIVE SUMMARY Interim Report
George A. Hazelrigg, Jr. 30 Jun. 1976 38 p
(Contract NAS8-31308)
(NASA-CR-150146; Rept-76-145-2-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 10A

The technical and economic aspects of satellite solar power systems are presented with a focus on the current configuration 5000 MW system. The technical studies include analyses of the orbital system structures, control and stationkeeping, and the formulation of program plans and costs for input to the economic analyses. The economic analyses centered about the development and use of a risk analysis model for a system cost assessment, identification of critical issues and technologies, and to provide information for programmatic decision making. A preliminary economic examination of some utility interface issues is included. Under the present state-of-knowledge, it is possible to formulate a program plan for the development of a satellite solar power system that can be economically justified. The key area of technological uncertainty is man's ability to fabricate and assemble large structures in space. Author

N77-15495*# Grumman Aerospace Corp., Bethpage, N.Y.
SPACE-BASED SOLAR POWER CONVERSION AND DELIVERY SYSTEMS STUDY. VOLUME 2: ENGINEERING ANALYSIS OF ORBITAL SYSTEMS Interim report
30 Jun. 1976 373 p refs
(Contract NAS8-31308)
(NASA-CR-150147; Rept-76-145-2-Vol-2) Avail: NTIS HC A16/MF A01 CSCL 10A

Program plans, schedules, and costs are determined for a synchronous orbit-based power generation and relay system. Requirements for the satellite solar power station (SSPS) and the power relay satellite (PRS) are explored. Engineering analysis of large solar arrays, flight mechanics and control, transportation, assembly and maintenance, and microwave transmission are included. Author

N77-15496*# ECON, Inc., Princeton, N.J.
SPACE-BASED SOLAR POWER CONVERSION AND DELIVERY SYSTEMS STUDY. VOLUME 3: ECONOMIC ANALYSIS OF SPACE-BASED SOLAR POWER SYSTEMS Interim Report
George A. Hazelrigg, Jr. 30 Jun. 1976 169 p refs
(Contract NAS8-31308)
(NASA-CR-150148; Rept-76-145-2-Vol-3; IR-2) Avail: NTIS HC A08/MF A01 CSCL 10A

A variety of economic and programmatic issues are discussed concerning the development and deployment of a fleet of space-based solar power satellites (SSPS). The costs, uncertainties and risks associated with the current photovoltaic SSPS configuration, and with issues affecting the development of an economically viable SSPS development program are analyzed. The desirability of a low earth orbit (LEO) demonstration satellite and a geosynchronous (GEO) pilot satellite is examined and critical technology areas are identified. In addition, a preliminary examination of utility interface issues is reported. The main focus of the effort reported is the development of SSPS unit production, and operation and maintenance cost models suitable for incorporation into a risk assessment (Monte Carlo) model (RAM). It is shown that the key technology area deals with the productivity of man in space, not, as might be expected, with some hardware component technology. Author

N77-15497*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ANALYSIS OF INFORMATION SYSTEMS FOR HYDROPOWER OPERATIONS
Robert L. Sohn, Leonard Becker, John Estes, David Simonett, and William W.-G. Yeh Sep. 1976 336 p refs
(Contract NAS7-100)
(NASA-CR-149373; JPL-5040-44; RTOP-777-30-01) Avail: NTIS HC A15/MF A01 CSCL 10C

The operations of hydropower systems were analyzed with emphasis on water resource management, to determine how aerospace derived information system technologies can increase energy output. Better utilization of water resources was sought through improved reservoir inflow forecasting based on use of hydrometeorologic information systems with new or improved sensors, satellite data relay systems, and use of advanced scheduling techniques for water release. Specific mechanisms for increased energy output were determined, principally the use of more timely and accurate short term (0-7 days) inflow information to reduce spillage caused by unanticipated dynamic high inflow events. The hydrometeorologic models used in predicting inflows were examined to determine the sensitivity of inflow prediction accuracy to the many variables employed in the models, and the results used to establish information system requirements. Sensor and data handling system capabilities were reviewed and compared to the requirements, and an improved information system concept outlined. Author

N77-15498# Hittman Associates, Inc., Columbia, Md.
COMPARATIVE EVALUATION OF SOLAR HEATING ALTERNATIVES
H. M. Curran and M. Miller 1976 9 p refs Presented at 2d Southeastern Conf. on Appl. of Solar Energy, Baton Rouge, La., 21-23 Apr. 1976
(Contract E(11-1)-2703)
(COO-2703-2; Conf-760423-2) Avail: NTIS HC A02/MF A01

An analysis of alternative approaches to the use of solar energy for heating applications is presented. Three heat pump configurations were considered as alternatives to direct heat exchange. These were two configurations of a vapor compression heat pump driven by a solar-powered Rankine engine and a solar-powered absorption heat pump which used the heat of condensation in the Rankine cycle as part of the input to the thermal load. ERA

N77-15499# California Univ., Livermore. Lawrence Livermore Lab.
PYROLYSIS OF OIL SHALE: THE EFFECTS OF THERMAL HISTORY ON OIL YIELD
N. D. Stout, G. J. Koskinas, J. H. Raley, S. D. Santor, R. J. Opila, and A. J. Rothman 27 Apr. 1976 32 p refs Presented at 9th Oil Shale Symp., Golden, Colo., 29-30 Apr. 1976
(Contract W-7405-eng-48)
(UCRL-77831; Conf-760443-2) Avail: NTIS HC A03/MF A01

The effect of thermal history on the oil yield of a powdered, 22-gallon-per-ton Colorado shale was studied by heating to test temperature at Fischer assay rate, holding a test temperature for varying times up to 33 d, and finally heating to 500 C at 12 C/min. Test temperatures covered the range of 150 to 450 C. Both autogenous and inert sweep gas atmospheres were used. Under autogenous atmospheres at test temperatures of 250 C or below, yields obtained were 100 percent of Fischer assay. Heating at 300 to 425 C resulted in yield losses, maximizing at 19 percent after a 33 d exposure at 350 C. Yield losses were accompanied by increased char in the retorted shale and by production of oil that was lower in density and nitrogen content, and higher in hydrogen. In the inert gas sweep experiments, increasing flow rates gave increased oil yields, approaching 100 percent assay. Author (ERA)

N77-15500# Braun (C. F.) and Co., Alhambra, Calif.
COAL GASIFICATION COMMERCIAL CONCEPTS: GAS COST GUIDELINES
R. Skamser Jan. 1976 39 p
(Contract E(49-18)-1235)
(FE-1235-1) Avail: NTIS HC A03/MF A01

The manufacture of synthetic natural gas from coal is discussed. Information and procedures required to calculate, on a consistent basis, the cost of producing high-Btu pipeline quality gas from coal using the design basis for the gasification plants is included. Coal analyses, unit prices (as of January 1, 1976), environmental requirements, plant size, equipment design guides, and equations for gas costs are provided using either utility or private investor financing. The cost of gas is determined primarily by the plant investment which is obtained from estimates of the installed cost of equipment. Methods of estimating vary with the agency or organization performing the work and are therefore not included in this procedure. These variations in estimating methods employed could result in gas costs significantly different from those developed here. However, if the cost estimates of installed equipment are developed by a neutral and reputable contractor experienced in building large industrial facilities, the results should be comparable. ERA

N77-15501# Foster Wheeler Corp., Livingston, N.J.
DEVELOPMENT WORK FOR AN ADVANCED COAL GASIFICATION SYSTEM FOR ELECTRIC POWER GENERATION FROM COAL DIRECTED TOWARD A COMMERCIAL GASIFICATION GENERATING PLANT, PHASE 2 Quarterly Progress Report, Oct. - Dec. 1975
Apr. 1976 35 p
(Contract E(49-18)-1521)
(FE-1521-13) Avail: NTIS HC A03/MF A01

Efforts involved test runs of the proposed coal pulverizing and drying equipment. Solids feeding systems were investigated. Material balances (flows) during startup were calculated. Computer calculations on the water wash and sour water stripping tower, the sulfur removal process (Selexol) and the sulfur recovery system are given. Specifications for various support facilities and environmental protection installations were issued. Work continued on the conceptual design of a commercial plant, especially with respect to cold flow model tests and computer calculations of effects of transients in the system, including the gas-cleanup system. Author (ERA)

N77-15502# Parsons (Ralph M.) Co., Pasadena, Calif.
PRELIMINARY DESIGN SERVICES COAL CONSERVATION DEMONSTRATION PLANTS Annual Report, Jan. - Dec. 1975
Mar. 1976 108 p
(Contract E(49-18)-1775)
(FE-1775-3; Rept-114) Avail: NTIS HC A06/MF A01

Key objectives and progress in preliminary conceptual plant design and economic evaluations for advanced technology coal conversion complexes are reported. Major effort centered on development of conceptual designs to produce both clean liquid fuels and SNG using Oil/Gas and Fischer-Tropsch technologies. The Oil/Gas concept uses modified SRC hydroliquefaction combined with production of significant co-product SNG. Liquid production rates are approximately 80,000 and 50,000 barrels per day respectively. A procedure for rapid economic comparison of process alternates was adopted; the procedure and representative quantitative results are presented. Detailed analysis of process step efficiencies resulted in predicted increased thermal efficiencies; expected efficiency for each design is expected to be in the 70-75 percent range. Author (ERA)

N77-15503# Carnegie-Mellon Univ., Pittsburgh, Pa.
CATALYTIC SYNTHESIS OF GASEOUS HYDROCARBONS Quarterly Report, Sep. - Nov. 1975
A. L. Dent Dec. 1975 49 p
(Contract E(49-18)-1814)
(FE-1814-2) Avail: NTIS HC A03/MF A01

The objectives of this program are to develop improved catalyst systems for preparation of gaseous hydrocarbons from coal-derived mixtures of CO and H2, and to develop a fundamental understanding of methanation and Fischer-Tropsch syntheses. To accomplish the first objective, two versatile catalytic reactor units (CRU-1 and CRU-2) were designed to screen a variety of Fe(-), Co(-), and Ni(-) based catalysts. During a report period, work was devoted primarily to the areas of equipment assembly, preliminary catalyst screening tests, and preliminary mechanistic studies. Improved temperature flexibility of CRU-1 was achieved by modification of the reactor's furnace and preheater. Electrical components were completed and installed in CRU-2, three nondispersive ir analyzers were mounted and tested, and the

gas chromatographic system was assembled. A training program utilizing olefin hydrogenation was undertaken to prepare for the initial tests of a typical Fischer-Tropsch catalyst in CRU-1. Finally poor quality ir spectra of Ni aerosols prompted a detailed modeling of the aerosol-generation method. ERA

N77-15504# Sandia Corp., Albuquerque, N.Mex.
BRANCHED THERMOCOUPLE CIRCUITS IN UNDERGROUND COAL GASIFICATION EXPERIMENTS
R. P. Reed 1976 12 p refs Presented at the 22d Intern. Instr. of the Instr. Soc. of Am., San Diego, Calif., 25 May 1976 Sponsored by ERDA
(SAND-75-5910; Conf-760513-5) Avail: NTIS HC A02/MF A01

The theory of branched thermocouple circuits is presented, their use in subsurface coal gasification experiments is described, and the need for diagnostic measurements in the interpretation of data made indefinite by noise content is illustrated. ERA

N77-15505# Lummus Co., New York.
HOT AND DRY CHAR LET DOWN SYSTEM FOR THE SYNTHANE DEMONSTRATION PLANT, PHASE 1 Final Report
31 Oct. 1975 71 p refs
(Contract E(36-2)-0058)
(PERC-0058-4) Avail: NTIS HC A04/MF A01

A program to design, simulation test and fabricate a commercially scaleable system to discharge dry char from the synthane pilot plant at as high a temperature as possible is discussed. Engineering designs are presented. Author (ERA)

N77-15506# American Cyanamid Co., Bound Brook, N.J. Chemical Research Div.
CONCEPT FOR FLUIDIZED BED COMBUSTION OF CONSOL CHAR USING A CLOSED-CYCLE HELIUM POWER PLANT WITH AN ESTIMATE OF THE PRICE OF ELECTRIC POWER Final Report
A. Himmelblau and J. Norton Apr. 1976 113 p
(Contract E(49-18)-2201)
(ERDA-76-69; FE-2201-4) Avail: NTIS HC A06/MF A01

The Consol process for making synthetic crude oil from coal produces char as a by-product which can be burned in a fluidized bed. Instead of using steam as the working fluid, helium was chosen, since a higher working temperature may allow a higher cycle efficiency. To develop a competent design required solution of a heat exchanger network designed to introduce as much heat as possible into the closed helium cycle. A computer model to generate flowsheets and cost data from specified inputs was developed. The net efficiency of the best design was only about 33.5 percent, since about 17.9 percent of the heat input to the cycle is used to calcine dolomite used to remove S in the fluidized bed. Lowering the amount of dolomite required or regenerating dolomite would be methods to improve the efficiency. Although the efficiency of the helium cycle is lower than that for a conventional coal-fired steam plant, the capital cost is lower (about $370/kW). ERA

N77-15507# Gilbert Associates, Inc., Reading, Pa.
PARTICIPATING SURVEILLANCE SERVICES FOR ELECTRIC POWER PROGRAM. COAL CONVERSION AND UTILIZATION: DIRECT COMBUSTION OF COAL-90e, ADVANCED POWER-90f. SUMMARY FOR ERDA ANNUAL REPORT, CY 1975
Mar. 1976 7 p refs
(Contract E(49-18)-1236)
(FE-1236-4) Avail: NTIS HC A02/MF A01

Efforts in providing technical and engineering services to ERDA by way of surveillance, evaluation, technical and economic review and recommendations are reported. These efforts were mainly in the area of combustion and fluidized-bed combustion of coal, but included also the high temperature gas turbine program, closed cycle inert gas and alkali metal systems, advanced heat exchangers, etc. New proposals, modifications, extensions, etc. of such work were also evaluated for technical and economic feasibility, commercial application potential and estimate of time required for useful results. Specific studies and reports are described briefly. Plans for continued work are given. ERA

N77-15508# California Univ., Livermore. Lawrence Livermore Lab.
ENERGY AND TECHNOLOGY REVIEW
R. B. Carr Feb. 1976 28 p refs
(Contract W-7405-eng-48)
(UCID-52000-76-2) Avail: NTIS HC A03/MF A01

A high stability space frame to support the 20 beam Shiva laser system within exacting tolerances is described. Studies of small scale self focusing and whole beam distortion on Cyclops enabled one to control these nonlinear propagation phenomena and improve beam brightness. A new form of spectroscopy provides important experimental data on the excited states of uranium. ERA

N77-15509# Hanford Engineering Development Lab., Richland, Wash.
ECONOMIC ANALYSIS OF THE NEED FOR ADVANCED POWER SOURCES
R. W. Hardie and R. P. Omberg 14 Nov. 1975 17 p refs Presented at Am. Nucl. Soc. 1975 Winter Meeting, San Francisco, 16-21 Nov. 1975
(Contract AT(45-1)-2170)
(HEDL-SA-989; Conf-751101-77) Avail: NTIS HC A02/MF A01

The economic need for an advanced power source, be it fusion, solar, or some other concept, is considered. However, calculations were also performed assuming abandonment of the LMFBR program, so breeder benefits are a by-product of this study. The model used was the ALPS linear programming system for forecasting optimum power growth patterns. Total power costs were calculated over a planning horizon from 1975 to 2041 and discounted at 7 1/2 percent. The benefit of a particular advanced power source is simply the reduction in total power cost resulting from its introduction. Since data concerning advanced power sources (APS) are speculative, parametric calculations varying introduction dates and capital costs about a hypothetical APS plant were performed. Calculations were also performed without the LMFBR to determine the effect of the breeder on the benefits of an advanced power source. ERA

N77-15510# RAND Corp., Santa Monica, Calif.
POSSIBLE EFFECTS OF NUCLEAR INITIATIVE ON SUPPLY AND USE OF ELECTRICITY IN CALIFORNIA
Deane N. Morris Dec. 1975 20 p Presented at the Hearings on the Calif. Nucl. Safeguards Initiative; sponsored by the Assembly Comm. on Resources, Land Use and Energy
(AD-A026582; P-5547) Avail: NTIS HC A02/MF A01 CSCL 10/2

This report was prepared for presentation at the hearings on the California Nuclear Safeguards Initiative held by the Assembly Committee on Resources, Land Use and Energy. Rand recently completed a study for this committee on the future sources and uses of energy in California, and identified and discussed the major energy policy issues facing the state. Among many other issues, questions of electricity use and generation alternatives were addressed in the study. This testimony is based on the results of that work. GRA

N77-15511# Office of Naval Research, London (England).
ENERGY AND PHYSICS: GENERAL CONFERENCE OF THE EUROPEAN PHYSICAL SOCIETY
Roy F. Potter 7 Jun. 1976 17 p Third Conf. held in Bucharest, Romania, 9-12 Sep. 1975
(AD-A026962; ONRL-C-14-76) Avail: NTIS HC A02/MF A01 CSCL 10/1

This report covers portions of most of the plenary sessions including the opening session of the Conference, Physics and Energy; Energy Strategies; Maturity of Nuclear Energy; Use of Solar Energy; New Goals and Challenges; Photochemistry; Thermonuclear Research; Energy, Dissipation and Structure; Transport and Storage of Energy. Other sessions covered are on solar energy use, transport and storage of energy and energy research strategies. GRA

N77-15512# Naval Ship Research and Development Center, Annapolis, Md. Propulsion and Auxiliary Systems Dept.
ALUMINUM-BASED ANODES FOR UNDERWATER FUEL CELLS: A PHASE REPORT Research and Development

Report, Jul. - Dec. 1971
H. B. Urbach and M. C. Cervi Jun. 1976 29 p
(AD-A026405; PAS-76-5) Avail: NTIS HC A03/MF A01 CSCL 10/2

The anodic properties of various aluminum alloys were studied potentiostatically with measurement of hydrogen evolution and potential. Also, an aluminum-oxygen fuel cell was examined for its polarization behavior. Hydrogen evolution at the aluminum anode represents a serious loss of efficiency, since the metal is consumed without delivery of power to the external circuit. The lowest rate of anodic hydrogen evolution at any given potential was measured on high-purity aluminum, since impurities tend to increase the rate of hydrogen evolution. Temperature studies on aluminum fuel cells indicate that power efficiency drops severely over 50 C. At 50 C, power efficiencies exceeding 50% at a power density of 100 A/sq ft (108 mA/sq cm) were obtained. At 175 and 225 A/sq ft (188 and 242 mA/sq cm), the power efficiency dropped to 40% and 30%, respectively. Freon may be circulated through the fuel cell during periods of reduced or no load to diminish the hydrogen self-discharge with no adverse effects after restarting. The aluminum-seawater system exhibits high-energy density, but it is rather inactive. Aluminum-lithium alloys coupled with seawater appear to be more desirable systems than those of pure aluminum because of their higher reactivity (power density), higher specific energy, and self-activating properties (no caustic inventory required). Author (GRA)

N77-15513# EIC, Inc., Newton, Mass.
LITHIUM-INORGANIC ELECTROLYTE BATTERIES Quarterly Report, 16 Dec. 1975 - 15 Mar. 1976
Joseph R. Driscoll, Gerhard L. Holleck, David E. Toland, and S. Barry Brummer Jun. 1976 54 p refs
(Contract DAAB07-74-C-0030; DA Proj. 1T1-61102-A-34A) (AD-A026069; C-401-10; ECOM-74-0030-10; QR-10) Avail: NTIS HC A04/MF A01 CSCL 10/3

The purpose of the present program is to study the feasibility of an all-inorganic electrolyte lithium primary battery operable and storable over the temperature range of -40 F to +160 F. The desired energy density is 150 watt-hours per pound of total battery weight and the desired power density is 50 watts per pound. The program work has centered along two lines: the reaction stoichiometry of the cell discharge via chemical analysis of the reaction products, and the problem of Li/SOCl2 cell passivation during storage at 71 C with a view to finding practical solutions to this problem. Qualitative analyses indicated the presence of LiCl, S and SO2 as reaction products of the cell discharge. Storage of Li/SOCl2 cells at elevated temperature and subsequent discharge at room temperature result in large voltage delays and voltage depression. This continues to be a major problem in the utilization of the Li/SOCl2 cell. Studies show that the cause of the passivation is the formation of a nonconductive film on the Li anode during storage, especially at elevated temperatures. The authors research efforts have been directed at studying film formation, and modifying the film to improve cell performance. GRA

N77-15514# Dow Chemical Co., Walnut Creek, Calif.
RESEARCH DEVELOPMENT IN THE GLASS FIBER SODIUM-SULFUR Semiannual Report, 1 Jul. - 31 Dec. 1975
Charles A. Levine 31 Dec. 1975 31 p
(Contract DAHC15-73-C-0254; ARPA Order 2381)
(AD-A026359) Avail: NTIS HC A03/MF A01 CSCL 10/3

The sodium-sulfur battery based on hollow glass fibers as the electrolyte has been shown to have outstanding characteristics as a rechargeable cell. It should be capable of 100 watt hours per pound at over 80 watts per pound, and not be damaged by charge/discharge cycling. The major problems are to obtain increased lifetimes, to demonstrate non-variance in its electrochemical characteristics over thousands of cycles, and to assemble the cells into metal envelopes and into high voltage batteries. The batteries, like the cells, must be capable of long-lived non-variant operation. The problems are being defined and attacked by building and operating various size hollow fiber cells. These cells range from single fiber cells to cells containing many thousands of fibers. When these cells fail, the failure mode is analyzed. Small assemblies are designed and built that can test specific parts of the cells which may be involved in the failure. For example, single fibers or small bundles of fibers can be assembled and used as a Na anode discharging and charging into a sodium or a sulfide pool to test the effect of passage of sodium ions on the glass lifetime. As improvements are made, the cells are scaled up to confirm the improvements and to see if scaling up introduces new factors affecting the cell lifetime. GRA

N77-15515# Defence Research Establishment Ottawa (Ontario).
NICKEL/CADMIUM AIRCRAFT BATTERIES: FAILURE PREDICTION IN BATTERY SHOPS BY GASSING RATE MEASUREMENTS
K. Feldman, R. L. Haines, and R. Hayashi May 1976 21 p refs
(AD-A026197; DREO-TN-76-12) Avail: NTIS HC A02/MF A01 CSCL 10/3

One of the serious problems which face a battery shop responsible for maintenance of nickel/cadmium aircraft batteries is to identify cells which would be likely to fail during the next period of service on board the aircraft. At present it seems that nearly all of the catastrophic battery failures which arise on board are due to failure of the separator materials in the cells. In the majority of cases it is likely that gradual deterioration of the separators takes place over a period of time at a rate which in large measure depends on the details of the stress to which the battery is subjected, and in particular to the thermal stress involved. This document discusses two modes of failure due to separator deterioration and how the deterioration may be detected at an early stage by measurement of gas emission. GRA

N77-15516# California Univ., Los Angeles. School of Engineering and Applied Science.
ENGINEERING ANALYSIS OF SHAPE CHANGE IN ZINC SECONDARY ELECTRODES Final Report, Nov. 1973 - Nov. 1975
King Wai Choi, Drannan Hamby, Douglas N. Bennion, and John Newman Mar. 1976 133 p refs
(Contract F33615-74-C-2004; AF Proj. 3145)
(AD-A026551; UCLA-ENG-7634; AFAPL-TR-76-9) Avail: NTIS HC A07/MF A01 CSCL 10/3

Shape change, the redistribution of active material over the zinc electrode surface as a result of cell cycling, is hypothesized to be caused by convective flows driven primarily by membrane pumping. A mathematical model is formulated based on the convective flow hypothesis for the zinc-silver oxide secondary cell and tested by actual cell experiments. The numerical solutions predict redistributions of zinc material over the zinc electrode, fluid flow rates, variations of current distribution, and cell potential with the number of cycles. These numerical calculations are compared quantitatively to the experimental observations. The results show that shape change can be eliminated if the convective flow in the zinc electrode compartment parallel to the electrode surface is stopped. Author (GRA)

N77-15517# Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.
SURFACE RESEARCH FOR DEVELOPMENT OF NEW ELECTROCATALYSTS FOR ACID ELECTROLYTE FUEL CELLS
Johann A. Joebstl 1976 15 p refs
(AD-A026053) Avail: NTIS HC A02/MF A01 CSCL 10/2

The mechanisms of selected electrochemical reactions are very similar to the mechanisms of the appropriate heterogeneous catalytic gas reactions. Therefore heterogeneous catalytic reactions can be utilized to screen materials for their potential applicability as electrocatalysts in fuel cells. Similarly, surface research on supported catalysts supplies invaluable information of the chemical interaction between catalyst and substrate and thus furthers the development of electrocatalysts with increased temperature stability. Author (GRA)

N77-15518# Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.
AN IMPROVED ELECTROLYTE FOR DIRECT OXIDATION FUEL CELLS
Grayson W. Walker, Richard V. Lawrence, and Alayne A. Adams 1976 14 p refs
(AD-A026164) Avail: NTIS HC A02/MF A01 CSCL 10/3

This technological base of the modern Army is heavily dependent on electrical power generation for its sophisticated weapons, communications and detection systems. The diversity of such systems has resulted in no single power generation system being suitable for all applications. The engine generator and secondary battery have long been the mainstays for field generator sets, with dependability and ease of transportation being two of their more important characteristics. With the increasing trend toward equipment mobility and the development of new sensitive intrusion and detection devices, which must operate in remote locations, undetected by the enemy, as well as in command areas, new emphasis is being placed on silence, efficiency and long term life capabilities. The fuel cell, and in particular the direct oxidation fuel cell, has the capability of meeting the electrical power requirements for low power applications. GRA

N77-15519# Army Electronics Command, Fort Monmouth, N.J. Electronics Technology and Devices Lab.

COMPOSITE MATERIAL STRUCTURES FOR THERMOPHOTOVOLTAIC CONVERSION RADIATOR

G. Guazzoni and E. Kittl Sep. 1975 27 p refs
(DA Proj. 1T1-61102-A-34A)
(AD-A026859; ECOM-4351) Avail: NTIS HC A03/MF A01 CSCL 10/2

This report covers the experimental work on the testing and evaluation of disk-shaped erbium oxide radiator samples fabricated by die pressing and plasma spray coating techniques. This investigation was performed to provide performance parameters on the utilization of these specimen structure compositions as improved radiator structures for thermophotovoltaic energy conversion applications. Author (GRA)

N77-15520# California Univ., Riverside. Inst. of Geophysics and Planetary Physics.

COOPERATIVE GEOCHEMICAL RESOURCE ASSESSMENT OF THE MESA GEOTHERMAL SYSTEM Final Report

Tyler B. Coplen Mar. 1976 118 p refs
(Contract DI-14-06-300-2479)
(PB-257225/3; IGPP-UCR-76-1) Avail: NTIS HC A06/MF A01 CSCL 08I

In order to effectively develop this geothermal resource the Bureau of Reclamation began conducting a reservoir analysis study in 1972. Information was obtained about water rock interactions and about the hydrogeology of this system. In particular, data pertinent to the quantity of water flowing past each gram of sediment was obtained by using stable isotope studies of oxygen, carbon and hydrogen. GRA

N77-15521# Army Facilities Engineering Support Agency, Fort Belvoir, Va.

DUAL PURPOSE NUCLEAR POWER PLANTS FOR MILITARY INSTALLATIONS

Anthony V. Nida and Gary S. Stewart 1976 14 p refs
(AD-A026141) Avail: NTIS HC A02/MF A01 CSCL 18/5

The authors have found evidence that the nuclear total energy system is technically feasible and capable of economically serving the utility needs of military installations. The recovery of thermal energy from a direct-cycle high-temperature gas-cooled reactor would result in significant reductions in thermal emissions and air pollution and aid in the conservation of fossil-fuel resources. Provision of electricity and thermal energy from a nuclear energy center should be considered for total energy systems in appropriately sized urban communities. This concept will accrue the greatest benefits in areas where air quality degradation is to be kept to a minimum and where dependable fuel supply must be guaranteed. GRA

N77-15522# General Electric Co., Schenectady, N.Y. Research and Development Center.

PROGRAM AND ABSTRACTS FOR THE INTERNATIONAL CONFERENCE ON SUPERIONIC CONDUCTORS: CHEMISTRY, PHYSICS, AND APPLICATIONS Final Report

G. D. Mahan and W. L. Roth May 1976 56 p refs Conf. held at Schenectady, N. Y., 10-12 May 1976
(Contract F44620-76-C-0087; AF Proj. 9767)
(AD-A026352; AFOSR-76-0699TR) Avail: NTIS HC A04/MF A01 CSCL 10/3

Substantial improvements are needed in organic and solid electrolytes to increase conductivity to that achieved in aqueous electrolytes. These solid electrolytes have a much wider temperature range and are needed to be used in new high energy, high charge and discharge rates rechargeable batteries. The objectives met in this symposium is to foster discussions among scientists from diverse fields regarding the status of understanding superionic conductors and the new problems in physics created by advancing technology. Author (GRA)

N77-15523# Federal Energy Administration, Washington, D.C. Office of Oil and Gas.

TRENDS IN REFINERY CAPACITY AND UTILIZATION: PETROLEUM REFINERIES IN THE UNITED STATES; FOREIGN REFINERY EXPORTING CENTERS

E. L. Peer and F. V. Marsik Jun. 1976 47 p
(PB-256966/3; FEA/G-75/710) Avail: NTIS HC A03/MF A01 CSCL 07A

Data concerning actual and planned refinery capacities are presented for refineries in the U.S., Caribbean area, Middle East, Eastern Canada, Italy, and Singapore. Net exportable capacities are given through 1979. GRA

N77-15524# National Bureau of Standards, Washington, D.C. Center for Building Technology.

THE STRUCTURE OF BUILDING SPECIFICATIONS

Steven J. Fenves (Carnegie-Mellon Univ., Pittsburgh, Pa.), Kirk Rankin, and K. Tejuja Hotchand Sep. 1976 85 p refs
(PB-257581/9; NBS-BSS-90; LC-76-26695) Avail: NTIS HC A05/MF A01 CSCL 13A

A scientific basis is provided for the formulation and expression of performance standards and specifications and for explicit attention to performance in procedural and prescriptive standards and specifications. The provisions of the NBS developed interim performance criteria for solar heating and combined heating/cooling systems and dwellings, a performance specification, are classified in terms of the physical entities addressed, the attributes of the built environment, and the properties which group together particular physical entities which may be subject to similar dysfunctions. GRA

N77-15525# National Bureau of Standards, Washington, D.C. Solar Energy Program.

INTERMEDIATE MINIMUM PROPERTY STANDARDS FOR SOLAR HEATING AND DOMESTIC HOT WATER SYSTEMS Interim Report

Apr. 1976 173 p refs Sponsored by HUD
(PB-257086/9; NBSIR-76-1059) Avail: NTIS HC A08/MF A01 CSCL 13A

Standards for the use of solar heating and domestic hot water systems in residential applications are presented. The standards were developed for application in numerous housing programs of the Department of Housing and Urban Development. To the greatest extent possible, these standards are based on current state-of-the-art practice and on nationally recognized standards including the MPS and the HUD interim Performance Criteria for Solar Heating and Combined Heating/Cooling Systems and Dwellings. GRA

N77-15526# Gordian Associates, Inc., New York.

ENERGY CONSERVATION: A STUDY OF THE ENERGY SAVING POSSIBLE BY AUTOMATIC CONTROL OF MECHANICAL DRAFT COOLING TOWER FANS

15 Nov. 1975 25 p refs Sponsored by FEA
(PB-256683/4; FEA/D-76/030; Conservation Paper-41; FEA/D-CP-41) Avail: NTIS HC A02/MF A01 CSCL 13A

The potential saving in energy use that may be achieved through application of various control systems to mechanical draft towers was calculated. A hypothetical 100-million-Btu-per-hour tower located in the Houston area is used as an example. Since each existing or proposed cooling tower must, in fact, be treated as a separate case, the study should be considered to indicate the magnitude of the energy savings associated with selected control systems. Evaluation of each control option for a specific tower may, of course, indicate different payout periods from those shown in this report, depending on local marginal electricity rates, climatic conditions, cooling load, and actual capital investment costs for equipment. GRA

N77-15527# Department of Housing and Urban Development, Washington, D.C.
RAPID GROWTH FROM ENERGY PROJECTS: IDEAS FOR STATE AND LOCAL ACTION. A PROGRAM GUIDE
Apr. 1976 66 p refs Prepared in cooperation with the Federal Energy Admin., Washington, D.C.
(PB-257374/9; HUD-CPD-140; FEA/G-76/394) Avail: NTIS HC A04/MF A01 CSCL 10A

The purposes of this publication are: to show what the community impacts of energy projects are likely to be; to share ideas for action among communities, based on actual experiences; and to point out sources of help - for information planning and financial assistance. GRA

N77-15528# Electric Power Research Inst., Palo Alto, Calif. Nuclear Power Div.
NUCLEAR UNIT PRODUCTIVITY ANALYSIS
Melvin E. Lapides Aug. 1976 73 p refs
(PB-257553/8; EPRI-SR-46) Avail: NTIS HC A04/MF A01 CSCL 18E

Licensing, procurement and operations evaluations of generation units involve assessments of unit safety, reliability, availability and productivity. The safety assessments are characterized by a well-developed methodology and by conservative regulatory decrees in areas where data uncertainties may exist. The remaining assessments draw on a lesser developed methodology with no convenient options for dealing with recognized data shortcomings. GRA

45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

N77-15529 Wisconsin Univ., Milwaukee.
TRAJECTORY ANALYSES OF MESOSCALE AIR POLLUTION TRANSPORT IN THE LAKE MICHIGAN SHORELINE ENVIRONMENT Ph.D. Thesis
Cecil Sidney Keen 1976 260 p
Avail: Univ. Microfilms Order No. 76-28014

A technique whereby actually observed lake breeze wind data are used in a a kinematic diagnostic model to compute instantaneous three-dimensional streamlines and time-integrated trajectories are presented in an attempt to better understand complex shoreline mesoscale transport phenomena. A series of time-space matrices were assembled at 15 minute intervals through a 24 hour period with each matrix having a horizontal resolution of 0.25 km and a vertical resolution of 100 m. Assuming that there was no variation of the wind parallel to the shoreline, the one-dimensional divergence was used to compute the vertical motion. Particles could be released at any point in space or time and up to 1000 particles could be simultaneously handled. Graphical plots of the trajectories were based upon locating the parcel at 360 second intervals. Dissert. Abstr.

N77-15530*# Kanner (Leo) Associates, Redwood City, Calif.
THE ACTION OF SST EMISSIONS ON THE OZONE LAYER
E. A. Brun Jan. 1977 19 p Transl. into ENGLISH from La Meteorologie (France), Mar. 1976 p 71-80
(Contract NASw-2790)
(NASA-TT-F-17312) Avail: NTIS HC A02/MF A01 CSCL 13B

Mass transfer mechanisms in the stratosphere are described together with periodic changes in the global distribution of stratospheric ozone. Mechanisms proposed for the production and destruction of ozone are reviewed, with particular emphasis placed on the role of nitrogen oxides at different altitudes. It is estimated that the sum of the volume molar fractions of NO, NO2 and HNO3 between 20 and 35 km is practically constant, with a value of about 12.10 times ten to the minus ninth power. A large portion of these nitrogen compounds originated in the natural processes of denitrification of organic materials. It is further estimated that a yearly 0.39 per cent reduction in the ozone layer could occur as a result of the flight of a fleet of 100 Concorde-type supersonce transports at altitudes of 16-17 km in the Northern Hemisphere; the corresponding figure for SST-type transports, flying at 20 km altitude, is about 4 percent. A 0.39 per cent yearly reduction of the ozone layer may be expected to result in one additional fatality per annum due to skin malignancies in France. Author

N77-15531*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A COMPUTER SIMULATION OF THE AFTERBURNING PROCESSES OCCURRING WITHIN SOLID ROCKET MOTOR PLUMES IN THE TROPOSPHERE
Richard I. Gomberg and Roger B. Stewart Washington Dec. 1976 43 p refs
(NASA-TN-D-8303; L-10964) Avail: NTIS HC A03/MF A01 CSCL 13B

As part of a continuing study of the environmental effects of solid rocket motor (SRM) operations in the troposphere, a numerical model was used to simulate the afterburning processes occurring in solid rocket motor plumes and to predict the quantities of potentially harmful chemical species which are created. The calculations include the effects of finite-rate chemistry and turbulent mixing. It is found that the amount of NO produced is much less than the amount of HCl present in the plume, that chlorine will appear predominantly in the form of HCl although some molecular chlorine is present, and that combustion is complete as is evident from the predominance of carbon dioxide over carbon monoxide. Author

N77-15532*# Old Dominion Univ. Research Foundation, Norfolk, Va. Dept. of Physics and Geophysical Sciences.
A THEORETICAL/EXPERIMENTAL PROGRAM TO DEVELOP ACTIVE OPTICAL POLLUTION SENSORS
Frank S. Mills, Roger N. Blais, and Earl C. Kindle 1977 53 p refs
(Grant NsG-1060)
(NASA-CR-149394; PGSTR-AP77-47) Avail: NTIS HC A04/MF A01 CSCL 14B

Light detection and ranging (LIDAR) technology was applied to the assessment of air quality, and its usefulness was evaluated by actual field tests. Necessary hardware was successfully constructed and operated in the field. Measurements of necessary physical parameters, such as SO2 absorption coefficients were successfully completed and theoretical predictions of differential absorption performance were reported. Plume modeling improvements were proposed. A full scale field test of equipment, data analysis and auxiliary data support was conducted in Maryland during September 1976. Author

N77-15533# California Univ., Livermore. Lawrence Livermore Lab. Biomedical and Environmental Research Div.
OVERVIEW OF THE IMPERIAL VALLEY ENVIRONMENTAL PROJECT
L. R. Anspaugh, ed. and P. L. Phelps, ed. 8 Apr. 1976 14 p Presented to the Natl. Geothermal Conf., Palm Springs, Calif., 19-22 Apr. 1976
(Contract W-7405-eng-48)
(UCID-17067; Conf-760450-1) Avail: NTIS HC A02/MF A01

A long-term project to acquire complete understanding of the environmental quality in the Imperial Valley of California was initiated to ensure that the development of geothermal resources proceeds on an environmentally sound basis. Consequently, the Imperial Valley Environmental Project (IVP) is committed to an intensive and comprehensive study designed to establish an environmental baseline for the Imperial Valley as well as to develop an understanding of the environmental and other effects associated with development of geothermal resources. The IVP is organized into seven main study sections, which when taken together cover all the significant issues and concerns. The sections are: Air Quality; Water Quality; Ecosystem Quality, (Soil, Plants, Animals, etc.); Subsidence and Induced Seismicity; Health Effects; Socio-Economics; and an Integrated Assessment. Author (ERA)

N77-15534# Southern Research Inst., Birmingham, Ala.
ELECTROSTATIC PRECIPITATORS: RELATIONSHIP BETWEEN RESISTIVITY, PARTICLE SIZE, AND SPARKOVER Final Report, Apr. 1974 - Dec. 1975
Herbert W. Spencer, III May 1976 71 p refs

(Contract EPA-02-1303)
(PB-257130/5; SORI-EAS-75-629; EPA-600/2-76-144; Rept-3134-16) Avail: NTIS HC A04/MF A01 CSCL 07A

Results of a study of the relationships of the electrical resistivity of fly ash, its particle size, the occurrence of back corona and sparkover, and the electrical characteristics of electrostatic precipitators (ESP's) are reported. Laboratory measurement of the dielectric strengths and resistivity of five particle size fractions of a fly ash sample are included along with the measurement of the current densities and voltages at which back corona and sparkover occur. Results showed that the peak current density for the formation of back corona depended on the resistivity of the dust covering the positive electrode. Operating current densities for full scale ESP's are discussed in relation to fly ash resistivity. GRA

N77-15535# Environmental Monitoring and Support Lab., Research Triangle Park, N.C. Quality Assurance Branch.
THE APPLICATION OF EPA METHOD 6 TO HIGH SULFUR DIOXIDE CONCENTRATIONS Final Report
Joseph E. Knoll and M. Rodney Midgett Jul. 1976 25 p refs
(PB-257104/0; EPA-600/4-76-038) Avail: NTIS HC A02/MF A01 CSCL 07D

The use of prepared gas mixtures showed that the method is efficient for the measurement of gaseous sulfur dioxide in concentrations of up to 80,000 mg/m. When multiple impinger trains were employed, analysis of individual impinger contents showed that more than 99% of the sampled sulfur dioxide was collected in the first two impingers, even at the higher concentration, except when sufficient sample was collected to deplete the hydrogen peroxide in the absorbing solutions or when excessively high flow rates were used. GRA

N77-15536# Bolt, Beranek, and Newman, Inc., Canoga Park, Calif.
SENSITIVITY STUDIES OF COMMUNITY-AIRCRAFT NOISE EXPOSURE (NOISEMAP) PREDICTION PROCEDURE
Dwight E. Bishop, Tom C. Dunderdale, Richard D. Horonjeff, and John F. Mills Wright-Patterson AFB, Ohio AMRL Mar. 1976 123 p refs
(Contract F33615-75-C-5044; AF Proj. 7231)
(AD-A026535; BBN-2956; AMRL-TR-75-115) Avail: NTIS HC A06/MF A01 CSCL 20/1

This report describes a preliminary study of the sensitivity of noise exposure contours to various aircraft noise modeling parameters and assumptions. The study is the first step in a continuing technical assessment of the Air Force community-aircraft noise exposure (NOISEMAP) prediction procedure. The results indicate that the addition of a tone correction to the noise measure can result in appreciable increase in noise exposure areas, but the increase is highly dependent on the type of aircraft operations. Computation of contour areas for nine bases with and without the ground runup penalty showed how the percent of area impacted increased with increasing noise exposure level. Use of alternate algorithms for ground-to-ground propagation and transitions for air-to-ground and ground-to-ground situations is discussed. GRA

N77-15537# Rensselaer Polytechnic Inst., Troy, N.Y.
ROLE OF POLYELECTROLYTES IN THE FILTRATION OF COLLOIDAL PARTICLES FROM WATER AND WASTEWATER Ph.D. Thesis Final Project Report, 15 Jun. 1975 - 30 Jun. 1976
William W. Shuster and Lawrence K. Wang Jun. 1976 62 p refs
(Contract DAAG53-75-C-0252)
(AD-A027330; RPI-JBA02-3) Avail: NTIS HC A04/MF A01 CSCL 07/1

An extensive review has been made of the literature in connection with the use of polyelectrolytes in the removal of colloidal particles from water and wastewater by mechanisms of filtration. Pertinent literature on the nature of colloidal materials and current theory related to particle interactions and coagulation has been briefly reviewed. Present thought on the physical aspects and the chemical aspects of filtration has been considered. References related to the characterization and behavior of multi-media filters as well as single media filters were included in this work. Particular attention was directed to the review and evaluation of articles related to specific applications of the use of polyelectrolytes in water treatment, and in domestic and industrial wastewater treatment. GRA

N77-15538# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
CHEMISTRY AND MICROBIOLOGY OF WATER
L. B. Dolivo-Dobrovolskii, L. A. Kulskii, and V. F. Nakorchevskaya 1975 343 p refs Transl. into ENGLISH of Mono. Khim. i Mikrobiol. Vody (Kiev), 1971 306 p
(AD-A027708; CRREL-TL-506) Avail: NTIS HC A15/MF A01 CSCL 13/2

The book discusses the chemical and microbiological processes taking place in reservoirs, tanks and ponds, and during purification of natural and sewage waters. Particular attention is devoted to problems of chemical and biological purification, intensification of the methods of treating natural and sewage waters, new reagents and improvement of the treatment method. The textbook is designed for students at engineering-construction institutes with the specialty of 'Water Supply and Sewage Systems'. It will also be useful to engineering and technical personnel in studying, planning and operating water lines and sewage purification installations. GRA

N77-15539# Kentucky Univ., Lexington. Inst. for Mining and Minerals Research.
HOT FUEL GAS DESULFURIZATION
J. T. Shrodt and O. J. Hahn May 1976 35 p refs
(PB-257036/4; IMMR15-PD11-76) Avail: NTIS HC A03/MF A01 CSCL 07A

The scope of the hot fuel gas desulfurization problem is summarized. The levels of impurities found in coal-derived fuel gases, and the tolerances of gas turbines for these are presented. Two conceptual schemes for recovering energy from low Btu gases subject to high and low temperature desulfurization were compared. The basic concept of the IMMR hot ash desulfurization process, its chemistry and theoretical maximum efficiency were carefully examined. Finally, desulfurization results obtained in both fixed and fluidized beds of gasifier ash held at 800 to 1,500 F are presented and discussed. GRA

N77-15540# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Environmental Effects Lab.
POLLUTANT POTENTIAL OF RAW AND CHEMICALLY FIXED HAZARDOUS INDUSTRIAL WASTES AND FLUE GAS DESULFURIZATION SLUDGES Interim Report, Jan. - Aug. 1975
J. L. Mahloch, D. E. Averett, and M. J. Bartos, Jr. Cincinnati, Ohio EPA Jul. 1976 120 p refs
(Grant EPA-IAG-D4-0569)
(PB-256691/7; EPA-600/2-76-182) Avail: NTIS HC A06/MF A01 CSCL 13B

The potential environmental impact of raw sludge disposal is examined, and the technical merits of sludge fixation as a disposal pretreatment process are assessed. Both objectives are being accomplished by leachate testing, which can be evaluated by comparison to the raw sludges, and by durability testing, which reflects the environmental stability of the fixed products. Major points of discussion are the methods for physical and chemical analyses, documentation of the various sludge fixation processes, and the physical and chemical data that are presently available. GRA

N77-15541# Coordinating Research Council, Inc., New York.
COOPERATIVE STUDY OF HEAVY DUTY DIESEL EMISSION MEASUREMENT METHODS Final Report
Jul. 1976 88 p refs
(PB-257137/0; CRC-487; CRC-APRAC-CAPI-1-64-10) Avail: NTIS HC A05/MF A01 CSCL 13B

A cooperative test program was conducted to evaluate the technical aspects of a proposed EPA recommended heavy-duty diesel instrumentation and test procedure. The primary emphasis was on NO and NOx measurement methods and instrumentation. CO, CO2 and HC measurements were made by two participants using complete sampling and analysis systems. The various NOx instrument configurations used included vacuum and positive pressure chemiluminescent analyzers. GRA

N77-15542# Environmental Protection Agency, Washington, D.C. Office of Research and Development.
PROCEEDINGS OF THE EPA CONFERENCE ON ENVIRONMENTAL MODELING AND SIMULATION
Wayne R. Ott, ed. Jun. 1976 863 p refs Conf. held at Cincinnati, 19-22 Apr. 1975 Prepared in cooperation with Booz-Allen Appl. Res., Inc., Chicago
(PB-257142/0; EPA-600/9-76-016) Avail: NTIS HC A99/MF A01 CSCL 13B

Technical papers on environmental modeling efforts in air quality management, air and water pollutant transport processes, water runoff, water supply, solid waste, environmental management and planning, environmental economics, environmental statistics, ecology, noise, radiation, and health are presented. The Conference was directed toward the technical and administrative communities faced with the need to make environmental decisions and predict future environmental phenomena. GRA

N77-15543# Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
FILTRATION CHARACTERISTICS OF GLASS FIBER FILTER MEDIA AT ELEVATED TEMPERATURES Final Report, Jul. 1974 - Jul. 1975
Dale A. Lundgren and Thomas C. Gunderson Jul. 1976 96 p refs
(Grant EPA-R-803126-01)
(PB-257132/1; EPA-600/2-76-192) Avail: NTIS HC A05/MF A01 CSCL 13B

Particle collection characteristics of a high purity micro-quartz fiber filter media and a Gelman type A glass fiber filter media were evaluated over a range of temperatures (20C to 540C), particle sizes (0.05 micrometer to 26 micrometers), gas velocities (.5 cm/sec to 51 cm/sec), and particle volatilities. Both types of high efficiency filters proved adequate for sampling nonvolatile particles over the above variable ranges. Nonvolatile particle penetration decreased with increasing temperature and increasing filter loading. The effect elevated temperature had on particle collection characteristics was not a determining factor in the application of high efficiency filters. The main problems encountered in the high temperature environment were filter holder leakage and volatilization of gas-borne particles that passed through the filter media. GRA

N77-15544# North Carolina State Univ., Raleigh.
EFFICIENT USE OF FIBROUS STRUCTURES IN FILTRATION Final Report, Jun. 1972 - Jun. 1976
M. Mohamed and E. Afify Jul. 1976 147 p refs
(Grant EPA-R-801441)
(PB-257147/9; EPA-600/2-76-204) Avail: NTIS HC A07/MF A01 CSCL 13B

A project to develop fibrous structures for air filtration which are economical and efficient, and have low pressure drop, was examined. The structure of needle punched fabrics showed excellent characteristics as filter media. Fundamental studies were carried out to investigate the effect of different needled fabric parameters on their filtration performance and mechanical properties. High efficiency levels were obtained at relatively low pressure drop, compared to woven fabrics. Fabric parameters studied were; needling intensity, fiber orientation and length, needle size and penetration, scrim material, fabric weight, and number of passages through the needling process. GRA

N77-15545# Research Triangle Inst., Research Triangle Park, N.C.
THE REGIONAL AIR POLLUTION STUDY (RAPS) GRID SYSTEM Final Report
Richard C. Haws, Richard E. Paddock, and Charles C. Masser Dec. 1975 170 p refs Sponsored by EPA
(PB-257148/7; EPA-450/3-76-021) Avail: NTIS HC A08/MF A01 CSCL 13B

The Regional Air Pollution Study (RAPS), which encompasses the St. Louis Air Quality Control Region, is the largest and most comprehensive attempt to date to obtain a quantitative understanding of urban air pollution. Its aim is to describe the complex relationships between emissions to the atmosphere, atmospheric dispersions and transformation processes, and ambient concentrations of pollutants. With the initiation of the RAPS, the need to grid the study area was required to present area source emissions on a sub-county basis. Included in the report are computer drawn maps of the whole RAPS area and each county. The maps include county and river outlines and the assigned numbers for each grid square. GRA

N77-15546# Gordian Associates, Inc., New York.
ENERGY CONSERVATION. A STUDY OF THE RELATIVE ECONOMICS AND TOTAL ENERGY REQUIREMENTS OF NATURAL DRAFT AND MECHANICAL DRAFT COOLING TOWERS
Dec. 1975 25 p refs Sponsored by FEA
(PB-256762/6; FEA/D-76/032; FEA/D-CP-42) Avail: NTIS HC A02/MF A01 CSCL 13A

The capital investment, operating costs, and energy requirements for the construction and operation of conventional mechanical draft and natural draft cooling towers were compared. Two sizes of tower were examined, corresponding to cooling duties of 1,000 million and 5,000 Btu per hour. The natural draft tower required more energy than the mechanical draft tower for both sizes studied for construction, and for tower operation. GRA

N77-15547# California Univ., Irvine.
ENVIRONMENTAL QUALITY RESEARCH. THE PHYTOTOXICITY OF MISSILE EXHAUST PRODUCTS: SHORT TERM EXPOSURES OF PLANTS TO HCl, HF AND Al2O3 Annual Report, 16 Jun. 1974 - 31 May 1975
Shimshon Lerman Wright-Patterson AFB, Ohio AMRL May 1976 53 p refs
(Contract F33615-73-C-4059; AF Proj. 6302)
(AD-A026837; AMRL-TR-75-102; AR-2) Avail: NTIS HC A04/MF A01 CSCL 06/6

Eight species of ornamentals and three garden plants were selected in order to determine the range of phytotoxic responses to hydrogen chloride, hydrogen fluoride and alumina particles. The experimental plants were grown in a greenhouse or growth chambers or growth chambers under controlled conditions. Two exposure chambers were constructed to accomodate the exposure of plants to both gaseous and particulate pollutants. Methods and equipment for the generation, dispensing and monitoring of pollutants were established. Plants of various age levels from each species were exposed to the missile products at various concentrations for periods of 10 or 20 minutes each. Plants received a single exposure for phytotoxic range-finding studies as well as multiple exposure to determine cumulative effects of toxicants. Growth conditions such as temperature, relative humidity and light intensity which could affect plant responses were also under investigation. The exposed plants were evaluated 24 to 48 hours after exposure, and injury symptoms were recorded. GRA

N77-15548# Ecological Analysts, Inc., Baltimore, Md.
COOLING WATER DISCHARGE RESEARCH PROJECT Progress Report
Lucien M. Brush, Jr., Loren D. Jensen, and M. Gordon Wolman Feb. 1976 116 p refs Revised Sponsored by EPRI Prepared in cooperation with Johns Hopkins Univ., Baltimore
(PB-257673/4; EPRI/EC-141) Avail: NTIS HC A06/MF A01 CSCL 13B

Among the topics reported are the design, construction and calibration of a test flume to study the interaction of fish species with cooling water systems intakes; laboratory and field experiments to determine impact of entrainment on zooplankton populations; a workshop on biofouling control procedures and their ecological effects; a study of the natural mortality rate of striped bass eggs; development of containment structured for studying the response of phytoplankton populations to perturbations; and the application of a mathematical model to study the effect of algal destruction on dissolved oxygen concentrations. GRA

N77-15549# Environmental Research Lab., Duluth, Minn.
EFFECTS OF WASTEWATER AND COOLING WATER CHLORINATION ON AQUATIC LIFE
William A. Brungs Aug. 1976 52 p refs
(PB-257700/5; EPA-600/3-76-098) Avail: NTIS HC A04/MF A01 CSCL 13B

The literature since 1972 pertaining to wastewater and cooling

water chlorination is discussed under the following headings: review papers, chlorinated municipal wastewaters, continuously chlorinated water, intermittently chlorinated water, dechlorination, avoidance, formation of chlorinated organic compounds, aquatic life criteria and application factors, and regulations. Field and laboratory research results support a single criterion of 0.003 mg/l for continuous exposure of freshwater organisms. The former distinction between warmwater and coldwater systems is no longer appropriate; recent data indicate that several freshwater fish species are as sensitive as trout and salmon. GRA

N77-15550# Midwest Research Inst., Kansas City, Mo.
PERFORMANCE OF EMISSION CONTROL DEVICES ON BOILERS FIRING MUNICIPAL SOLID WASTE AND OIL Final Report, Jul. 1975 - Jun. 1976
J. B. Galeski and M. P. Schrag Jul. 1976 128 p refs
(Contract EPA-68-02-1324)
(PB-257136/2; EPA-600/2-76-209) Avail: NTIS HC A07/MF A01 CSCL 21D

Particulate flue gas loadings were estimated for combined firing of shredded municipal waste (MSW) and oil, using existing data on particulate emissions from oil-fired electric utility boilers and from waterwall (steam generating) incinerators firing either waste or waste-plus-coal/oil auxiliary fuel. Control device performance was estimated for several planned oil/MSW resource recovery systems. On the basis of these estimates, installed particulate emission controls, designed for coal, are predicted to be significantly less efficient for control of particulate emissions from combined firing of oil/MSW. Anticipated control difficulties result mostly from high particulate loadings, high flue gas volumes, fine particulates, relatively low particle density, and relatively high fractions of carbonaceous low-resistivity particulate. GRA

N77-15551# Monsanto Research Corp., Dayton, Ohio.
UTILITY OF SOLID SORBENTS FOR SAMPLING ORGANIC EMISSIONS FROM STATIONARY SOURCES Final Report, May 1975 - May 1976
Arthur D. Snyder, F. Neil Hodgson, M. A. Kemmer, and J. R. McKendree Jul. 1976 81 p refs
(Contract EPA-68-02-1411)
(PB-257131/3; MRC-DA-567; EPA-600/2-76-201) Avail: NTIS HC A05/MF A01 CSCL 07D

The utility of porous polymer adsorbents as a means of sampling and concentrating trace organic emissions from stationary sources was assessed. Emissions from two industrial field sites were sampled, using small porous polymer sampling tubes backed up by a cryogenic thermal gradient sampling system to assess the efficiencies of adsorption of the trace organic species. In addition to experimental results, conclusions, and recommendations, a detailed statement of the problem of sampling trace organics in industrial emissions is presented. This later discussion includes: the characteristics of stationary sources emitting organic species; an assessment of present sampling techniques for organic matter; a review of the use of porous polymer adsorbents in sampling; and the characteristics of porous polymer sorbents and their potential limiting properties. GRA

N77-15552# Battelle Columbus Labs., Ohio.
CHEMICAL CHARACTERIZATION OF MODEL AEROSOLS Final Report, Jun. 1974 - Apr. 1976
W. E. Schwartz, G. D. Mendenhall, P. W. Jones, C. J. Riggle, and A. P. Graffeo Jul. 1976 89 p refs
(Grant EPA-R-801174)
(PB-257512/4; EPA-600/3-76-085) Avail: NTIS HC A05/MF A01 CSCL 07E

Model aerosols were generated from the individual hydrocarbons, pinenes, toluene and 1-heptene, by irradiation under simulated atmospheric conditions in the presence of NOx, or NOx/SO2. The reactions were carried out in a 17.3 cu m environmental chamber. The collected aerosols were subjected to analysis by mass spectrometry and chromatographic techniques, both with and without chemical derivatization. Polyfunctional oxidation products, including quinones and carboxylic acid, were tentatively identified in the toluene aerosol. The 1-heptene filtered aerosol was shown to contain condensation products from different 1-heptene molecules. Tentative identification of a number of vapor-phase species was accomplished in both systems. The health effects of the atmospheric oxidation products from hydrocarbons are discussed. GRA

N77-15553# Southern Research Inst., Birmingham, Ala.
WET ELECTROSTATIC PRECIPITATOR SYSTEM Final Report, May 1973 - Apr. 1975
John P. Gooch and Alan H. Dean May 1976 206 p refs
(Contract EPA-68-02-1313)
(PB-257128/9; SORI-EAS-75-651; EPA-600/2-76-142) Avail: NTIS HC A10/MF A01 CSCL 07A

Experiments on wet electrostatic precipitators (WESP) were aimed at determining collection efficiency as a function of particle size at varying current densities and specific collection areas. The results agreed reasonably with mathematical predictions. The feasibility of collecting SO2 and particulates in a WESP was examined. Calculation of ion transport rates indicated that only an insignificant amount of SO2 can be removed by selective ionization of SO2 molecules. Mass transfer calculations indicated that irrigated electrode surfaces would not provide sufficient interfacial area for desired SO2 removal levels. Based on conventional geometry and stainless steel construction, A WESP/scrubber device would be more costly than a scrubber-only system because of high WESP capital costs. The effectiveness of WESP as a mist eliminator following a scrubber was calculated to be a function of the particle size distribution and the concentration of the mist to be collected. A field test and literature survey showed that WESP's have been used effectively to control fine particle emissions in the aluminum, iron and steel, chemical and petrochemical fields. GRA

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N77-15554 Wisconsin Univ., Madison.
AIR MASS MODIFICATION IN THE ATMOSPHERE'S BOUNDARY LAYERS: A STUDY USING A TWO DIMENSIONAL NUMERICAL MODEL WITH A HIGHER ORDER TURBULENCE CLOSURE Ph.D. Thesis
Richard Alan Brost 1976 186 p
Avail: Univ. Microfilms Order No. 76-20101

A boundary layer numerical model has been developed and applied to examples of atmospheric air mass modification with durations of 2 seconds to 10 hours, vertical extents of 1 m to 2 km, and horizontal extents of 10 m to 150 km. Modeling air mass transformation over lakes was the emphasis of this research. The first application was to boat observations over Lake Mendota of modification over a horizontal scale of 4 km. Unstable conditions were modeled more successfully than stable ones. The second application was to airplane observations over Lake Michigan of modification with a horizontal scale of 150 km. The development of a stratus deck had a dominant influence on the turbulence profiles. Water was recycled in and out of the cloud, continually condensing and re-evaporating in a cycle which generated turbulence and increased the downward heat flux at the inversion by an order of magnitude over that found in a boundary layer with no phase change. Dissert. Abstr.

N77-15555 Wisconsin Univ., Madison.
A NUMERICAL STUDY OF THE CHEMICAL COMPOSITION OF THE STRATOSPHERE Ph.D. Thesis
Randolph William Ashby 1976 319 p
Avail: Univ. Microfilms Order No. 76-20653

Steady state and time-dependent one-dimensional models were used to describe stratospheric chemical composition and some of its variations. The effects of the earth's albedo and of multiple scattering in the lower stratosphere were studied; it was found that both significantly increased the solar flux available for photodissociation reactions and resulted in changes in stratospheric concentrations. The cosmic ray source of nitric oxide also was included; it was found to be an important source of odd nitrogen, especially in the lower stratosphere and in the polar latitudes. Concentrations of the nitrogen compounds

were found to be sensitive to cosmic ray fluctuations. It was found that during cosmic ray maxima, the increased nitrogen dioxide concentration reduces the solar flux reaching the troposphere, suggesting a correlation between solar inactivity and decreased temperatures on the earth. Dissert. Abstr.

N77-15556 Oregon Graduate Center for Study and Research, Portland.
SHORT TERM STATISTICS OF ATMOSPHERIC TURBULENCE AND OPTICAL PROPAGATION Ph.D. Thesis
Philip Ari Pincus 1976 128 p
Avail: Univ. Microfilms Order No. 76-26801

The statistical properties of the random processes describing optical wave propagagation through the turbulent atmosphere are considered. Of specific interest are the effects of short time averaging, necessitated by various circumstances, on the statistical measures of the random processes, most significantly the variances CN2, the atmospheric structure constant, and sigma chi2, the normalized variance of the log optical amplitude fluctuations. Details of the statistical properties, including probability distribution functions, power spectra and correlation functions are presented. These include the following results. Small scale atmospheric fluctuations, were highly non-Gaussian, with flatness factors as high as 14. The square of the temperature difference fluctuations, related to CN2, were nearly lognormally distributed in well developed turbulence, over a range of short averaging times. Dissert. Abstr.

N77-15557 Rutgers Univ., New Brunswick, N.J.
THE STATISTICAL BEHAVIOUR OF TURBULENT ENERGY DISSIPATION Ph.D. Thesis
Susana Isabel Guimard 1976 132 p
Avail: Univ. Microfilms Order No. 76-27006

The statistical properties of the dissipation of turbulent energy were examined. One of the principal problems inherent in its study arises from the representation of the dissipation in terms of only one or two velocity gradients. The statistics of local spatial averages of epsilon were studied for the case of grid-generated turbulence using different representations for epsilon. These representations involve the longitudinal gradient of longitudinal and/or transverse velocity fluctuations. The resulting expressions are all in principle equivalent theoretical representations. The statistical behavior epsilon was compared to the lognormal model. All representation agree with the lognormal model if the domain sizes used in local averages are larger than 1.6 cm and provide equivalent statistical results.
Dissert. Abstr.

N77-15558 Minnesota Univ., Minneapolis.
ANALYSIS AND APPLICATION OF NEW ARRAY TECHNIQUES FOR SEISMIC SIGNAL EXTRACTION Ph.D. Thesis
Fu Shing Li 1976 248 p
Avail: Univ. Microfilms Order No. 76-27812

Data-processing techniques for the extraction of the compressional reflected PP signal concealed by large coherent noise in short range seismic measurements. The range under consideration was a few meters to a few tens of meters. The principal interference noise under the experimental conditions was the large source-generated coherent Rayleigh surface wave. The methods involved combining the modified velocity, the Nth root, and the logarithmic filters with the techniques of high order cross-correlated product (CCP) and successively varying the assumed reflector depth. These multichannel processing techniques were newly developed except for the Nth root filter for which some new analyses were made. The modified velocity filters were designed to narrow down the accepted velocity range for the incoming waves. Dissert. Abstr.

N77-15559 Florida State Univ., Tallahassee.
THE PRODUCTION AND TRANSPORT OF OZONE AND OTHER MINOR CONSTITUENTS IN THE STRATOSPHERE Ph.D. Thesis
Robert John Kurzeja 1976 214 p
Avail: Univ. Microfilms Order No. 76-28630

The distribution of ozone and related chemicals in the stratosphere and mesosphere was investigated with a one dimensional, steady state model extending from 15 to 70 km, and with a two dimensional, time dependent model extending from pole to pole and from 7 to 45 km. The photochemistry of both models included compounds of hydrogen, nitrogen, and oxygen. Diurnal variations of the chemical concentrations and the scattering and reflection of solar radiation had an effect on ozone and were included in the models in parameterized form. The concentration of ozone from 30 to 45km obtained with the one-dimensional model exceeded the observed amount by 50 to 80 percent. The model also indicated that the concentration of the nitrogen oxides must be increased by a factor of from three to five to sufficiently reduce the computed ozone amount.
Dissert. Abstr.

N77-15560 Alabama Univ., Huntsville.
KINETIC DESCRIPTION OF IONOSPHERIC DYNAMICS IN THE THREE-FLUID APPROXIMATION Ph.D. Thesis
Richard Hugh Comfort 1975 257 p
Avail: Univ. Microfilms Order No. 76-29070

Conservation equations were first developed in the three-fluid approximation for general application to problems of ionospheric dynamics in the altitude region 90 km to 800 km for all geographic locations. These equations were then applied to a detailed study of auroral E region neutral winds and their relationship to ionospheric plasma motions. Dissert. Abstr.

N77-15561 Washington State Univ., Pullman.
THE ORIGIN OF MARINE MANGANESE NODULES AS DETERMINED BY TEXTURAL AND MINERALOGICAL ANALYSIS Ph.D. Thesis
Ronald Herbert Fewkes 1976 181 p
Avail: Univ. Microfilms Order No. 76-27725

The mineralogical and textural features found in marine manganese nodules were described. The depositional processes responsible for the formation of nodules were reflected in these features, and their proper interpretation should provide a basis for the formulation of an hypothesis of nodule origin. A total of 36 nodules collected from 14 different sites in the North Pacific, South Pacific, Southern Ocean, and the Atlantic were used. The nodules were studied using techniques of ore microscopy, X-ray diffraction, electron microprobe, and scanning electron microscopy. Both manganese-rich crystalline oxides and iron-rich X-ray amorphous oxides were found in various proportions in all nodules examined. The crystalline oxides include the minerals todorokite, birenessite, and variation -MnO2. Dissert. Abstr.

N77-15562 Wisconsin Univ., Madison.
WATER-AIR BOUNDARY INVESTIGATIONS Ph.D. Thesis
Paul Francis Twitchell 1976 169 p
Avail: Univ. Microfilms Order No. 76-20142

The vertical temperature structure changes near the water-air boundary with various materials on the surface were reported. A theoretical model based upon a heat balance equation was employed to obtain a quantitative measure of surface temperature changes due to conduction, radiation, and evaporation at the water-air boundary. Special emphasis was attributed to the evaporation term of the model. To test the model a laboratory was assembled, including a vertically moving thermistor and an infrared radiometer, to measure the temperature above, at the water surface, and below the water-air interface. The surface materials examined in the laboratory included cetyl alcohol, lake algae, and marine phytoplankton. Most surface materials were found to decrease the evaporation term of the model. A marine green flagellate, Dunaliella tertiolecta, appeared to substantially increase the evaporation across the water-air interface.
Dissert. Abstr.

N77-15563*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ATMOSPHERIC AEROSOLS: THEIR OPTICAL PROPERTIES AND EFFECTS
1976 316 p refs Conf. proc. held at Williamsburg, Va., 13-15 Dec. 1976; Sponsored by NASA Langley Research Center and the Optical Soc. of Am.
(NASA-CP-2004) Avail: NTIS HC A14/MF A01 CSCL 04A

Measured properties of atmospheric aerosol particles are presented. These include aerosol size frequency distribution and complex retractive index. The optical properties of aerosols are

computed based on the presuppositions of thermodynamic equilibrium and of Mie-theory. Author

N77-15564*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ATMOSPHERIC AEROSOLS: THEIR OPTICAL PROPERTIES AND EFFECTS (SUPPLEMENT)
1976 46 p refs Conf. proc. held at Williamsburg, Va., 13-15 Dec. 1976; sponsored by NASA Langley Research Center and the Optical Soc. of Am.
(NASA-CP-2004-Suppl) Avail: NTIS HC A03/MF A01 CSCL 04A

A digest of technical papers is presented. Topics include aerosol size distribution from spectral attenuation with scattering measurements; comparison of extinction and backscattering coefficients for measured and analytic stratospheric aerosol size distributions; using hybrid methods to solve problems in radiative transfer and in multiple scattering; blue moon phenomena; absorption refractive index of aerosols in the Denver pollution cloud; a two dimensional stratospheric model of the dispersion of aerosols from the Fuego volcanic eruption; the variation of the aerosol volume to light scattering coefficient; spectrophone in situ measurements of the absorption of visible light by aerosols; a reassessment of the Krakatoa volcanic turbidity, and multiple scattering in the sky radiance. A.H.

N77-15565*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPUTER SIMULATION OF EARTHQUAKES
Steven C. Cohen Nov. 1976 38 p refs Submitted for publication
(NASA-TM-X-71253; X-921-76-258) Avail: NTIS HC A03/MF A01 CSCL 08K

Two computer simulation models of earthquakes were studied for the dependence of the pattern of events on the model assumptions and input parameters. Both models represent the seismically active region by mechanical blocks which are connected to one another and to a driving plate. The blocks slide on a friction surface. In the first model elastic forces were employed and time independent friction to simulate main shock events. The size, length, and time and place of event occurrence were influenced strongly by the magnitude and degree of homogeniety in the elastic and friction parameters of the fault region. Periodically reocurring similar events were frequently observed in simulations with near homogeneous parameters along the fault, whereas, seismic gaps were a common feature of simulations employing large variations in the fault parameters. The second model incorporated viscoelastic forces and time-dependent friction to account for aftershock sequences. The periods between aftershock events increased with time and the aftershock region was confined to that which moved in the main event. Author

N77-15566*# Illinois Univ., Urbana. Aeronomy Lab.
AERONOMY REPORT NO. 73: ANALYSIS OF SOUNDING ROCKET DATA FROM PUNTA CHILCA, PERU
R. W. Fillinger, Jr., E. A. Mechtly, and E. K. Walton 1 Jul. 1976 76 p refs
(Grant NGR-14-005-181)
(NASA-CR-149385; UILU-ENG-76-2504; ISSN-0568-0581) Avail: NTIS HC A04/MF A01 CSCL 04A

A technique is described for measuring electron concentrations in the lower portion of the ionosphere above Punta Chilca. A radio-propagation experiment for measuring Faraday rotation is combined with a dc/Langmuir probe experiment for measuring electron current. The results obtained from the analysis of radio and probe data from Nike Apache 14.532, which was launched at 20:26 UT on May 28, 1975, at a solar zenith angle of 60 deg are presented. A comparison of the profiles of electron concentration indicates that the value of the maximum ionization in the D region under quiet conditions is proportional to the square of the cosine of the solar zenith angle. Author

N77-15567*# Illinois Univ., Urbana. Aeronomy Lab.
AERONOMY REPORT NO. 74: THE URBANA METEOR-RADAR SYSTEM; DESIGN, DEVELOPMENT, AND FIRST OBSERVATIONS
G. C. Hess and M. A. Geller 1 Oct. 1976 351 p refs
(Grants NGR-14-005-181; NSF ATM-76-01773)
(NASA-CR-149386; UILU-ENG-76-2505; ISSN-0568-0581) Avail: NTIS HC A16/MF A01 CSCL 04A

The design, development, and first observations of a high power meteor-radar system located near Urbana, Illinois are described. The roughly five-fold increase in usable echo rate compared to other facilities, along with automated digital data processing and interferometry measurement of echo arrival angles, permits unsurpassed observations of tidal structure and shorter period waves. Such observations are discussed. The technique of using echo decay rates to infer density and scale height and the method of inferring wind shear from radial acceleration are examined. An original experiment to test a theory of the Delta-region winter anomaly is presented. Author

N77-15568# California Univ., Livermore. Lawrence Livermore Lab.
CONSEQUENCES OF REDUCED FOOD SUPPLY INDUCED BY LOSS OF STRATOSPHERIC OZONE
R. C. Maninger and D. W. Dorn Apr. 1976 6 p refs Presented at 7th Ann. Conf. on Modeling and Simulation, Pittsburgh, 26 Apr. 1976
(Contract W-7405-eng-48)
(UCRL-77679; Conf-760435-3) Avail: NTIS HC A02/MF A01

The structure of the normal world as represented by WORLD 3 is such that a substantial perturbation of the global food supply does not trigger any unexpected drastic changes in the world socioeconomic system. The time responses of the world in general are somewhat delayed and slower than the perturbing function, OZONLY. The world system also displays capacity to recover in direct proportion to changes in OZONLY. The ozone reduction functions discussed represent worst case assumptions. More realistic ozone reduction factors are in the range of 10 percent for the Freon case and 5 percent for the SST case (versus this paper - 50 percent for both). These simulations suggest that there is essentially no current crisis to be considered with respect to stratospheric ozone depletion.ERA

N77-15569# National Oceanic and Atmospheric Administration, Boulder, Colo. World Data Center A for Solar-Terrestrial Physics.
ISO-INTENSITY CONTOURS OF GROUND MAGNETIC H PERTURBATIONS FOR THE DECEMBER 16-18, 1971 GEOMAGNETIC STORM
Y. Kamide (Colo. Univ., Boulder) Apr. 1976 45 p refs
(Grant NSF DES-74-23832)
(PB-247916-56; UAG-56; NOAA-76051902) Avail: NTIS MF A01; HC available from National Climatic Center, Federal Bldg. Attn: Publications, Asheville, N. C. 28801. Subscription $25.20/year, single copy $0.70 this issue CSCL 04A

Data of the geomagnetic storm which occurred between December 16-18 of 1971 is provided. Included are 720 contour maps which cover the entire period of the storm at 5-minute intervals. GRA

N77-15570*# National Oceanic and Atmospheric Administration, Boulder, Colo.
DESCRIPTION AND CATALOG OF IONOSPHERIC F-REGION DATA, JICAMARCA RADAR OBSERVATORY, NOVEMBER 1966 - APRIL 1969
W. L. Clark, J. P. McClure (Texas Univ., Austin), and T. E. VanZandt Apr. 1976 17 p refs
(NASA Order R-06-012-008)
(NASA-CR-149283; PB-247916-53; UAG-53; NOAA-76060806) Avail: NTIS MF A01; HC available from Natl. Climatic Center, Attn: Publications, Federal Bldg., Asheville, N. C. 28801. Subscription $25.20/year, $0.33 this issue CSCL 04A

Equatorial ionospheric F-region data reduced from the Jicamarca Radar Observatory (JRO) incoherent scatter observations for particular periods is described. It lists in catalog form the times of the observations made during those periods. These F-region data include the electron concentration and the electron and ion temperatures. The data were inferred from the incoherent scatter observations of JRO. GRA

N77-15571# National Oceanic and Atmospheric Administration, Boulder, Colo.
CATALOG OF IONOSPHERE VERTICAL SOUNDINGS
Apr. 1976 139 p refs
(PB-247916-54; UAG-54; NOAA-76060807) Avail: NTIS MF A01; HC available from National Climatic Center, Attn: Publications, Federal Bldg., Asheville, N.C. 28801. Subscription $25.20/year, $2.10 this issue CSCL 04A

The present catalog includes all known data since the beginning of systematic multifrequency ionospheric soundings; the earliest data set is 1930. Data are included for 310 stations throughout the world which have operated more or less systematically for at least a few months. The main body of the catalog gives for each station and for each month the World Data kinds of data held in the Center or known to exist. GRA

N77-15572# Air Force Geophysics Lab., Hanscom AFB, Mass.
ON MOTION ENVIRONMENTS Final Report
F. A. Growley and H. A. Ossing 15 Jul. 1976 10 p refs Presented at 1976 AIAA Guidance and Control Conf., San Diego, Calif., 17 Aug. 1976
(AF Proj. 7628)
(AD-A027198; AFGL-TR-76-0153) Avail: NTIS HC A02/MF A01 CSCL 20/11

The motion environment of the seismic observatory, the inertial hardware test facility and the siloed missile differ in important aspects. For the observatory, motion is the resultant of a large number of independent sources colored by transmission through the earth and observed in the far field. The test facility reflects the near field contributions of a modest number of seismic sources, while the siloed missile's motion can be quite unrelated to ground imputs. Our study considers a number of motion attributes of significance to inertial hardware performance for these three environments both for a quiescent state and following earthquakes. Author (GRA)

N77-15573# Systems Science and Software, La Jolla, Calif.
A DETERMINISTIC METHODOLOGY FOR DISCRIMINATING BETWEEN EARTHQUAKES AND UNDERGROUND NUCLEAR EXPLOSIONS Final Technical Report, 1 Apr. 1974 - 30 Jun. 1976
T. C. Bache, J. T. Cherry, D. G. Lambert, J. F. Masso, and J. M. Savino Jul. 1976 182 p refs
(Contract F44620-74-C-0063; ARPA Order 1827)
(AD-A027705; SSS-R-76-2925; AFOSR-76-0924TR) Avail: NTIS HC A09/MF A01 CSCL 17/10

The fundamental problem of interest is that of seismic discrimination. The approach is based on the development of deterministic computational models which predict the important characteristics of the teleseismic ground motion from earthquakes and underground explosions. The theoretical predictions are continuously compared to observations and in this way a confirmed theoretical framework is constructed for testing existing discriminants and for designing new ones. Much of this report is devoted to a study of the earthquake source. A three-dimensional finite difference model for earthquake faulting was developed and an earthquake simulation was carried out. Results from this complex, nonlinear earthquake simulation were compared to equivalent events computed with elastodynamic models of the relaxation and dislocation type. The interesting conclusion is that as a radiator of elastic waves, the finite difference source is similar to the relaxation/volume source model proposed by Archambeau. GRA

N77-15574# Texas Instruments, Inc., Dallas. Equipment Group.
VELA NETWORK EVALUATION AND AUTOMATIC PROCESSING RESEARCH Final Report, 1 Dec. 1974 - 31 Jul. 1975
Stephen S. Lane 31 Jul. 1975 40 p refs
(Contract F08606-75-C-0029; ARPA Order 2551)
(AD-A026183; TI-ALEX(01)-FR-75-01) Avail: NTIS HC A03/MF A01 CSCL 17/10

Work performed on Contract Number F08606-75-C-0029 has been reported in detail in a series of nine technical reports. This final report summarizes the material covered in each of the technical reports and discusses the conclusions obtained. The five tasks in the program were: A preliminary evaluation of the Korean Seismic Research Station; The development of an optimum automatic seismic detector; The investigation of adaptive beamforming techniques and distributed signal models as applied to interfering seismic events; The development of a network magnitude bias model, and the investigation of various short-period seismic discriminants; and The development and evaluation of an interactive graphics system for the PDP-15 computer to process seismic data, including data from the Seismic Research Observatories. GRA

N77-15575# Texas Instruments, Inc., Dallas.
AN AUTOMATIC SEISMIC DETECTION ALGORITHM Equipment Group.
David G. Black, III and Stephen S. Lane 3 Sep. 1975 42 p refs
(Contract F08606-75-C-0029; ARPA Order 2551; VT Proj. 5705/B/ETR)
(AD-A026177; TI-ALEX(01)-TR-75-07) Avail: NTIS HC A03/MF A01 CSCL 17/10

Fisher and conventional power automatic seismic signal detectors, utilizing threshold adjustment to realize a constant alarm rate, are developed and evaluated on Korean Short-Period Array Data. Detector performance is measured at different alarm rates and integration gate lengths, both with and without a non-causal quality control algorithm and a prefilter. The detectors ability to pick arrival times and event azimuths is analyzed. Frequency wave number detectors are designed and evaluated, and the feasibility of implementing the detectors on the Korean Station Processor is investigated. There was no significant difference between Fisher and conventional power detector performance at the same alarm rate, but both were improved with the use of the quality control algorithm and the prefilter. Azimuthal resolution was poor for all detectors, but the detectors were able to pick arrival times satisfactorily. One frequency-wavenumber detector consistently performed better than the others, and it was concluded that this type of detector offers no advantage over the wideband detectors. It was also found that either the Fisher or conventional power detector could be installed at the Korean Seismic Research Station (KSRS).
Author (GRA)

N77-15576# Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
RISK ANALYSIS FOR EARTHQUAKE-INDUCED GROUND FAILURE BY LIQUEFACTION
Mishac Yegian and Robert V. Whitman May 1976 331 p refs
(Grant NSF GI-27955)
(PB-256793/1; R76-22; NSF/RA-760194; Rept-26) Avail: NTIS HC A15/MF A01 CSCL 08M

A methodology is proposed to study the likelihood of ground failure by liquefaction. Two alternate probabilistic models are developed which consider the uncertainties present both in the methods of analysis employed and the parameters used. The first model is based on an empirical method of analysis for liquefaction which employs earthquake magnitude and hypocentral distance. The second probabilistic model is based on a modified version of a current method of analysis for liquefaction. These two models are later incorporated into risk analyses for liquefaction. Following the proposed procedure for liquefaction risk analysis, the actual site of a nuclear power plant is studied and the results are presented. GRA

N77-15577# Purdue Univ., Lafayette, Ind. School of Mechanical Engineering.
RADIATIVE EFFECTS OF POLLUTANTS ON THE PLANETARY BOUNDARY LAYER Interim Report
A. Venkatram and R. Viskanta Jul. 1976 262 p refs
(Grant EPA-R-803514)
(PB-257707/0; EPA-600/4-76-039) Avail: NTIS HC A12/MF A01 CSCL 04A

The effects of pollutants on the thermal structure and pollutant dispersal in the planetary boundary layer were studied. Numerical models of the boundary layer were constructed. Gaseous pollutants in the boundary layer were considered to absorb and emit thermal radiation, while aerosols were allowed to absorb and scatter solar energy. A one-dimensional numerical model of the boundary layer was constructed. The results showed

that the predominant influence of gaseous and particulate pollutants on surface temperature was warming. The second phase of the study involved the construction of a two-dimensional numerical model to study the effects of pollutants on urban-rural differences in thermal structure and pollutant dispersal. GRA

N77-15578# North Carolina State Univ., Raleigh. Dept. of Geosciences.
ATMOSPHERIC DISPERSION PARAMETERS IN GAUSSIAN PLUME MODELING. PART 1: REVIEW OF CURRENT SYSTEMS AND POSSIBLE FUTURE DEVELOPMENTS Report, Sep. 1975 - Mar. 1976
A. H. Weber Jul. 1976 74 p refs
(PB-257893/8; EPA-600/4-76-030-A-Pt-1) Avail: NTIS HC A04/MF A01 CSCL 04A

A recapitulation of the Gaussian plume model is presented and Pasquill's technique of assessing the sensitivity of this model is given. A number of methods for determining dispersion parameters in the Gaussian plume model are reviewed. Comparisons are made with the Pasquill Gifford curves presently used. Improved methods resulting from recent investigations are discussed. GRA

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N77-15579# Federal Aviation Administration, Washington, D.C.
COLLOCATED FLIGHT SERVICE STATION/AIR ROUTE TRAFFIC CONTROL CENTER AVIATION WEATHER UNIT, TASK 1 Final Report
L. J. Wuebker, E. Spring, E. Mandel, J. Langston (Kansas City Flight Service Station), and F. Blake (Mitre Corp., Washington, D. C.) Jul. 1976 74 p
(AD-A031099/5) Avail: NTIS HC A04/MF A01 CSCL 04/2

A comprehensive study and analysis was performed to determine optimum weather and aeronautical data collection, forecasting, and dissemination methodologies for a collocated Flight Service Station and Air Route Traffic Control Center environment. Special emphasis was placed on a centralized weather unit that would improve weather services to all facets of the aviation community as a result of collocating a Flight Service Station with an Air Route Traffic Control Center. Author

N77-15580*# Kanner (Leo) Associates, Redwood City, Calif.
AUTOMATIC WEATHER STATIONS FOR USE AT AIRPORTS
C. Fichaux Washington NASA Jan. 1977 12 p Transl. into ENGLISH from "Sta. Autom. d'Observation Meteorol. sur Aerodrome", Automated Meteorol. Systems, World Meteorol. Organ. (Geneva), rept. no.5 WMO-420, ISBN-92-63-10420-4, 1975 p 30-37
(Contract NASw-2790)
(NASA-TT-F-17373; WMO-420; ISBN-92-63-10420-4) Avail: NTIS HC A02/MF A01 CSCL 04B

Two automatic weather systems for use at French airports are described. The first (SAOMA) is based on a microprocessor with the task of determining visibility. The functioning, sensors, processing, and general organization of the station are described. The second system (IMCA) is intended to provide the user with details of a large number of meteorological parameters, including wind direction and speed, cloud height, air temperature and humidity, and pressure. This system is based on a minicomputer, the characteristics of which are outlined, and allows video as well as numeric output. Author

N77-15581*# Pennsylvania State Univ., University Park. Dept. of Meteorology.
CONTRIBUTIONS TO THE SIMULATION OF TURBULENCE
John A. Dutton, Bryan R. Kerman, and Erik L. Petersen Washington NASA Dec. 1976 284 p refs
(Contract NAS8-21140)
(NASA-CR-2762; M-191) Avail: NTIS HC A13/MF A01 CSCL 04B

The simulation modeling of turbulence in the boundary layer in consolidated in terms of boundary layer similarity principles and empirical results. The modeling is extended for some aspects of the nonlinear and non-Gaussian structure of the turbulence. Properties of the discrete gust form structure of the modeled turbulence are identified. Author

N77-15582*# GUS Manufacturing, Inc., El Paso, Tex.
FIELD SUPPORT, DATA ANALYSIS AND ASSOCIATED RESEARCH FOR THE ACOUSTIC GRENADE SOUNDING PROGRAM Final Report, 7 Feb. 1974 - 31 Oct. 1976
Thomas G. Barnes and Edwin R. Bullard 31 Oct. 1976 31 p
(Contract NAS5-20039)
(NASA-CR-144844) Avail: NTIS HC A03/MF A01 CSCL 04B

Temperature and horizontal winds in the 30 to 90 km altitude range of the upper atmosphere, were determined by acoustic grenade soundings conducted at Wallops Island, Virginia and Kourou, French Guiana. Field support provided at these locations included deployment of the large area microphone system, supervision, maintenance and operation of sound ranging stations; and coordination of activities. Data analysis efforts included the analysis of field data to determine upper atmospheric meteorological parameters. Profiles for upper atmospheric temperature, wind and density are provided in plots and tables for each of the acoustic grenade soundings conducted during the contract period. Research efforts were directed toward a systematic comparison of temperature data from acoustic grenade with other meteorological sensor probes in the upper atmosphere. Author

N77-15583*# National Aeronautics and Space Administration. Wallops Station, Wallops Island, Va.
SYNOPTIC ANALYSES, 5-, 2-, AND 0.4-MILLIBAR SURFACES, JULY 1973 - JUNE 1974
Washington 1976 144 p refs Prepared in cooperation with National Weather Service, Camp Springs, Md.
(NASA-SP-3102) Avail: NTIS HC A07/MF A01 CSCL 04A

Satellite radiance measurements and data from meteorological rocketsondes were employed to analyze a series of high-altitude constant pressure charts. The methods of processing the various types of data and the analysis procedure used are described. Broad-scale analyses for the Northern Hemisphere 5-, 2-, and 0.4-mb surfaces are presented for each week of the period from September through April, and on a once-per-month basis for July, August, May, and June. A brief discussion of the variations of the temperature and height fields throughout the year is also given. Author

N77-15584*# Ocean Data Systems, Inc., Rockville, Md.
METEOROLOGICAL ANALYSIS MODELS, VOLUME 2 Final Report
Rodger A. Langland and Darrell L. Stark Jul. 1976 143 p
(Contract NASw-2558)
(NASA-CR-149212) Avail: NTIS HC A07/MF A01 CSCL 04B

As part of the SEASAT program, two sets of analysis programs were developed. One set of programs produce 63 x 63 horizontal mesh analyses on a polar stereographic grid. The other set produces 187 x 187 third mesh analyses. The parameters analyzed include sea surface temperature, sea level pressure and twelve levels of upper air temperature, height and wind analyses. Both sets use operational data provided by a weather bureau. The analysis output is used to initialize the primitive equation forecast models also included. Author

N77-15585*# GCA Corp., Bedford, Mass.
TIDAL ANALYSIS OF MET ROCKET WIND DATA Final Report
J. Bedinger and E. Constantinides Apr. 1976 74 p refs
(Contract NAS6-2505)
(NASA-CR-141414) Avail: NTIS HC A04/MF A01 CSCL 04B

A method of analyzing Met Rocket wind data is described. Modern tidal theory and specialized analytical techniques were used to resolve specific tidal modes and prevailing components in observed wind data. A representation of the wind which is continuous in both space and time was formulated. Such a

representation allows direct comparison with theory, allows the derivation of other quantities such as temperature and pressure which in turn may be compared with observed values, and allows the formation of a wind model which extends over a broader range of space and time. Significant diurnal tidal modes with wavelengths of 10 and 7 km were present in the data and were resolved by the analytical technique. Author

N77-15586*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TETHERED BALLOON-BASED MEASUREMENTS OF METEOROLOGICAL VARIABLES AND AEROSOLS

Ronald J. Sentell, Richard W. Storey, James J. C. Chang (Systems and Applied Sciences Corp.), and Stephen J. Jacobsen Dec. 1976 317 p refs

(NASA-TM-X-73999) Avail: NTIS HC A14/MF A01 CSCL 04B

Tethered balloon based measurements of the vertical distributions of temperature, humidity, wind speed, and aerosol concentrations were taken over a 4-hour period beginning at sunrise on June 29, 1976, at Wallops Island, Virginia. Twelve consecutive profiles of each variable were obtained from ground to about 500 meters. These measurements were in conjuction with a noise propagation study on remotely arrayed acoustic range (ROMAAR) at Wallops Flight Center. An organized listing of these vertical soundings is presented. The tethered balloon system configuration utilized for these measurements is described. Author

N77-15587# Utah Univ., Salt Lake City.

EXPERIMENT ON MEAN AND TURBULENT MOTION IN AND ABOVE A CANYON

S. K. Kao and J. K. Lyon, Jr. Jan. 1976 46 p refs

(Contract E(11-1)-2455)

(COO-2455-8) Avail: NTIS HC A03/MF A01

Field measurements and wind tunnel simulations of a canyon wind were conducted. It is found that the main characteristics of the vertical distribution of the mean canyon wind are: (1) a strong jet flow fills the entire depth of the canyon; (2) a change in wind direction at about the canyon top; and (3) a comparatively weak return flow of about the same depth as the canyon jet occurs above the canyon top with its maximum about 25 percent of the maximum of the canyon jet. Simulation of the canyon flow in the wind tunnel reveals similar characteristics in the mean velocity profile measured in the canyon. It is also found that the maximum intensities of the longitudinal and vertical components of the turbulent motion as well as the vertical eddy transport of longitudinal momentum occurs near the maximum shear of the mean velocity in the flow. ERA

N77-15588# State Univ. of New York, Albany. Atmospheric Sciences Research Center.

CONTINUING SURVEY OF MARITIME AEROSOLS Final Report

Austin W. Hogan Dec. 1975 77 p refs

(Grants NOAA-04-4-022-11; NSF A-03252)

(PB-257985/2; NOAA-76062216) Avail: NTIS HC A05/MF A01 CSCL 04A

A series of aerosol and meteorological observations was obtained for the trade wind region, from a meteorological tower on the North shore of Oahu. These observations were supported by aircraft experiments and observations. The mean surface concentration found in trade winds is 242 n/cc, the median 222 n/cc, but extreme variation over the range 30 n/cc to 400 n/cc occurs. This extreme variation was found to be caused by aerosol removal by cumulus clouds, and may explain the periodicities in aerosol concentration. GRA

N77-15589# National Center for Atmospheric Research, Boulder, Colo.

THE NATIONAL HAIL RESEARCH EXPERIMENT REPORT ON THE ALBERT HAIL PROJECT

Joanne Simpson (Simpson Weather Associates, Charlottesville, Va.) Feb. 1976 52 p refs Prepared in cooperation with Virginia Univ., Charlottesville

(Contract NSF C-760)

(PB-257156/0; NCAR-7100-76/2) Avail: NTIS HC A04/MF A01 CSCL 04B

Airborne silver iodide seeding is used to test hail suppression in a 1,800 square mile target which experiences 55-65 hail days annually. Randomization by days occurs in the northern half of the target, with the exception of some south moving storms. Full operational seeding is conducted in the southern half. Seeding on top (at about -14 C) with droppable flares and at cloud base with fuses is executed by aircraft. The seed criterion is an echo intensity of 35 dbZ in or approaching the target. A potential response variable is hail kinetic energy as determined from a network of 600 stations with hailpads, raingages and sampling equipment. GRA

N77-15590# National Hurricane and Experimental Meteorology Lab., Coral Gables, Fla.

A STATISTICAL TECHNIQUE FOR EVALUATING HURRICANE MODIFICATION EXPERIMENTS

Richard W. Knight and Glenn W. Brier May 1976 17 p refs

(PB-258028/0; NOAA-TM-ERL-WMPO-29; NOAA-76062301)

Avail: NTIS HC A02/MF A01 CSCL 04B

A statistical technique was developed for evaluating the nonrandomized project STORMFURY hurricane seeding experiments. Modern principles of design and analysis of comparative experiments use: (1) replication, from which a quantitative estimate can be made of the experimental error or the variability of the response to a treatment, and (2) randomization, a process of allocating treatments to the experimental material by tossing a coin (or equivalent procedure), which may make it possible to attribute whatever effects are observed to the treatment only. Together, these two principles enable one to assess the validity of the results in terms of a probability statement. GRA

N77-15591# National Oceanic and Atmospheric Administration, Washington, D.C.

THE FEDERAL PLAN FOR METEOROLOGICAL SERVICES AND SUPPORTING RESEARCH, FISCAL YEAR 1977

Jun. 1976 60 p refs

(PB-258439/9; NOAA-76080316) Avail: NTIS HC A04/MF A01 CSCL 04B

Fiscal data for FY 1976, the transition period FY 197T, and FY 1977 are summarized. The basic and specialized meteorological services are each presented from an operational point of view along with the supporting research aimed at improving the individual services. This year the reporting of Agriculture and Forestry Meteorological Services was combined in one section. Similarly, Space Operations and Air Quality Meteorological Services were incorporated in Other Specialized Meteorological Services. Sections then follow that treat five distinct functions-observations, analyses and forecasts, communications, dissemination to users, and general agency support. GRA

N77-15592# National Oceanic and Atmospheric Administration, Washington, D.C. Environmental Data Service.

IFYGL RAWINSONDE SYSTEM: DESCRIPTION OF ARCHIVED DATA

Sandra M. Hoexter May 1976 59 p

(PB-258057/9; NOAA-TR-EDS-14; NOAA-76060801) Avail: NTIS HC A04/MF A01 CSCL 04B

The rawinsonde data collected during the international field year for the Great Lakes, a joint United States-Canadian program conducted from 1972 to 1973 for the study of Lake Ontario and its basin are described. Procedures used in data processing are described, and an inventory of the archived data is given. GRA

N77-15593# National Oceanic and Atmospheric Administration, Boulder, Colo. Wave Propagation Lab.

A SATURATION-RESISTANT OPTICAL SYSTEM FOR MEASURING AVERAGE WIND

G. R. Ochs, G. F. Miller, and E. J. Goldenstein Mar. 1976 19 p refs Sponsored by Army Electronics Command

(PB-257696/5; NOAA-TM-ERL-WPL-14; NOAA-76061501)

Avail: NTIS HC A02/MF A01 CSCL 04B

An optical system for measuring average crosswinds in the presence of strong integrated refractive-index turbulence is described. Circuit diagrams and adjustment instructions for the instrument are included. GRA

N77-15594# Calspan Corp., Buffalo, N.Y.
CHARACTERISTICS OF MARINE FOG OCCURRING OFF THE COAST OF NOVA SCOTIA Annual Summary Report, Part 1
Eugene J. Mack and Ulrich Katz Jun. 1976 185 p refs
(Contract N00019-75-C-0508; Proj. SEA FOG)
(AD-A027379; CALSPAN-CJ-5756-M-1) Avail: NTIS HC A09/MF A01 CSCL 04/2

This report contains data describing the micrometeorological, microphysical and chemical characteristics of marine fogs occurring in the area off the southeast coast of Nova Scotia.
GRA

N77-15595# Calspan Corp., Buffalo, N.Y.
SIMULATION OF MARINE ADVECTION FOG WITH THE CALSPAN ADVECTION FOG MODEL USING PROGNOSTIC EQUATIONS FOR TURBULENT ENERGY Annual Summary Report, Part 2
Eugene J. Mack and C. William Rogers Jun. 1976 43 p refs
(Contract N00019-75-C-0508; Proj. SEA FOG)
(AD-A027380; CALSPAN-CJ-5756-M-2; ASR-4) Avail: NTIS HC A03/MF A01 CSCL 04/2

Partial contents: The influence of radiative transfer on fog development; The influence of a warming sea surface on the development of advection fog; Observations of a marine advection fog; Numerical simulations of fog formed by turbulent heat exchange with a cold sea surface and comparison with observations.
GRA

N77-15596# Pennsylvania State Univ., University Park. Dept. of Meteorology.
ESTIMATION OF OUTGOING LONGWAVE AND SHORT-WAVE RADIATION FROM METEOROLOGICAL VARIABLES ACCESSIBLE FROM NUMERICAL MODELS
H. A. Panofsky, J. J. Cahir, J. Jensenius, and R. Stouffer 1976 52 p refs
(Grant NOAA-04-6-158-44013)
(PB-258424/1; NOAA-76080317) Avail: NTIS HC A04/MF A01 CSCL 04B

Statistical regression techniques were devised and tested for directly estimating infrared and short-wave radiation fluxes at the top of the atmosphere from conventional variables available in numerical forecast models. The relations were developed on the basis of a screening technique which used observed radiation flux from the NOAA 2 and 3 satellites as predictands, and predictors derived from variables available.
GRA

N77-15597# Systems Applications, Inc., San Rafael, Calif.
CONTINUED RESEARCH IN MESOSCALE AIR POLLUTION SIMULATION MODELING. VOLUME 1: ASSESSMENT OF PRIOR MODEL EVALUATION STUDIES AND ANALYSIS OF MODEL VALIDITY AND SENSITIVITY Final Report, Jun. 1974 - Jun. 1975
M. K. Liu, D. C. Whitney, J. H. Seinfeld, and P. M. Roth May 1976 263 p refs
(Contract EPA-68-02-1237)
(PB-257526/4; SAI/EF75-23-Vol-1; EPA-600/4-76-016-a) Avail: NTIS HC A12/MF A01; HC also available in set of 4 reports as PB-257525-SET, HC $30.50/MF $6.00 CSCL 04A

The sensitivity magnitude of predicted atmospheric pollutant concentrations due to variations in wind speed, diffusivity, mixing depth radiation intensity, and emissions rate. The results of the sensitivity analysis showed that variations in these key input variables influence predictions according to the following order of decreasing influence: wind speed, emissions rate, radiation intensity, mixing depth, vertical diffusivity, and horizontal diffusivity. Moreover, the responses of CO and NO2 tend to vary linearly with the meteorological and emissions parameters, whereas those of NO and O3 tend to be nonlinear.
GRA

N77-15598# Systems Applications, Inc., San Rafael, Calif.
CONTINUED RESEARCH IN MESOSCALE AIR POLLUTION SIMULATION MODELING. VOLUME 2: REFINEMENTS IN THE TREATMENT OF CHEMISTRY, METEOROLOGY, AND NUMERICAL INTEGRATION PROCEDURES Final Report, Jun. 1974 - Jun. 1975
S. D. Reynolds, J. Ames, T. A. Hecht, J. P. Meyer, and D. C. Whitney May 1976 303 p refs
(Contract EPA-68-02-1237)
(PB-257527/2; SAI/EF75-69-Vol-2; EPA-600/4-76-016-b) Avail: NTIS HC A14/MF A01; HC also available in set of 4 reports as PB-257525-SET, HC $3050/MF $6.00 CSCL 04A

The meteorology studies examined the sensitivity of the model to the inclusion of wind shear, algorithms for deriving mass-consistent wind fields, and the treatment of turbulent diffusivities and elevated inversion layers. Alternative numerical techniques for solving the advection/diffusion equation in grid models are evaluated, including various finite difference, particle-in-cell, and finite element methods, in an attempt to find a suitable methodology for accurately calculating the horizontal transport of pollutants. Finally, the report considers the problem of multiday model usage and presents results from a two day CO simulation for the Los Angeles basin.
GRA

N77-15599# Systems Applications, Inc., San Rafael, Calif.
CONTINUED RESEARCH IN MESOSCALE AIR POLLUTION SIMULATION MODELING. VOLUME 3: MODELING OF MICROSCALE PHENOMENA Final Report, Jun. 1974 - Jun. 1975
R. G. Lamb May 1976 245 p refs
(Contract EPA-68-02-1237)
(PB-257528/0; SAI/EF75-25-Vol-3; EPA-600/4-76-016-c) Avail: NTIS HC A11/MF A01; HC also available in set of 4 reports as PB-257525-SET, HC $30.50/MF $6.00 CSCL 04A

Mathematical techniques that influence the development of urban air pollution but are not resolvable by grid networks used in airshed simulation models were developed. These phenomena include turbulence-generated fluxes of pollutants, turbulence-induced fluctuations in the contaminant concentrations, and subgrid-scale variations in the mean concentration distributions. The problem of resolving the spatial details that exist in the mean concentration fields in the vicinity of point and line sources were examined. The problems of accounting for pollutant dispersion effects caused by buoyancy forces in hot stack exhausts was analyzed.
GRA

N77-15600# Systems Applications, Inc., San Rafael, Calif.
CONTINUED RESEARCH IN MESOSCALE AIR POLLUTION SIMULATION MODELING. VOLUME 4: EXAMINATION OF THE FEASIBILITY OF MODELING PHOTOCHEMICAL AEROSOL DYNAMICS Final Report, Jun. 1974 - Jun. 1975
T. N. Jerskey and J. H. Seinfeld May 1976 167 p refs
(Contract EPA-68-02-1237)
(PB-257529/8; SAI/EF75-26-Vol-4; EPA-600/4-76-016-d) Avail: NTIS HC A08/MF A01; HC also available in set of 4 reports as PB-257525-SET, HC $30.50/MF $6.00 CSCL 04A

The emission of primary particulates and gaseous precursors of secondary aerosols, homogeneous nucleation, heterogeneous condensation, heterogeneous chemical reaction, and coagulation are some of the theories and processes discussed along with an assessment of the relative importance of each in shaping the volume distribution of photochemical aerosols. It was concluded that in Los Angeles photochemical smog heterogeneous condensation is the principal mechanism for changes of the volume distribution in the accumulation size range. Coagulation must be considered in reshaping the size distribution of emissions and in reducing the number of particles formed by homogeneous nucleation. An in depth assessment is also presented of the pathways for the formation of aerosol material from the gas phase via homogeneous and heterogeneous chemistry. Finally, the equations governing the evolution of the photochemical aerosol are derived and simplified on the basis of order-of-magnitude calculations of the individual terms, and various equations for different properties of the aerosol are derived and discussed.
GRA

48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

N77-15601 Rhode Island Univ., Kingston.
THE GENERATION OF OCEANIC INTERNAL WAVES BY

ADVECTING AIR PRESSURE FIELDS Ph.D. Thesis
Edward Richard Levine 1976 160 p
Avail: Univ. Microfilms Order No. 76-25538

A solution was found to the linearized internal wave equation and appropriate boundary conditions describing internal wave generation by air pressure in a constant depth ocean, on an f plane, with arbitrary stratification. Using the response function derived by Mork, results were extended to consider the effects of wind stress. For the Garrett-Munk exponential bouyancy frequency profile, the effects of various forms of advecting atmospheric fields were considered. While random air pressure and windstress fields did not couple significantly with internal waves, step functions of wind stress and pressure modeling fronts produced forced oscillations with an energy transfer rate of .2 ergs sq cm sec. However, the bandwidth of the energy transfer narrowed with time, severely limiting the allowable variation of advection velocity. Dissert. Abstr.

N77-15602*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPARISON OF REMOTELY SENSED CONTINENTAL-SHELF WAVE SPECTRA WITH SPECTRA COMPUTED BY USING A WAVE REFRACTION COMPUTER MODEL
Lamont R. Poole Washington Dec. 1976 45 p refs
(NASA-TN-D-8353; L-11072) Avail: NTIS HC A03/MF A01 CSCL 08C

An initial attempt was made to verify the Langley Research Center and Virginia Institute of Marine Science mid-Atlantic continental-shelf wave refraction model. The model was used to simulate refraction occurring during a continental-shelf remote sensing experiment conducted on August 17, 1973. Simulated wave spectra compared favorably, in a qualitative sense, with the experimental spectra. However, it was observed that most of the wave energy resided at frequencies higher than those for which refraction and shoaling effects were predicted. In addition, variations among the experimental spectra were so small that they were not considered statistically significant. In order to verify the refraction model, simulation must be performed in conjunction with a set of significantly varying spectra in which a considerable portion of the total energy resides at frequencies for which refraction and shoaling effects are likely. Author

N77-15603*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ABSOLUTE CALIBRATION OF THE RADSCAT SCATTEROMETER USING PRECISION SPHERES
William L. Grantham, Lyle C. Schroeder, and John L. Mitchell (Vought Corp., Hampton, Va.) Washington Dec. 1976 45 p refs
(NASA-TN-D-8259; L-10554) Avail: NTIS HC A03/MF A01 CSCL 17I

Tests using precision sphere targets suspended from balloons were conducted to calibrate the received-power/transmitted-power tatio of the RADSCAT scatterometer. Comparisons were made of these measured results with theoretical return from spheres. The RADSCAT scatterometer measurements at 13.9 GHz should be corrected by -2.4 dB, and those at 9.3 GHz, by -4.3 dB. The techniques described should be generally applicable to calibration of scatterometers where measurement precision is of prime importance. Inferred from the magnitude of these RADSCAT corrections was the present state of technology in building precision scatterometers. Author

N77-15604# National Environmental Satellite Service, Washington, D.C.
SATELLITE DERIVED SEA SURFACE TEMPERATURES FROM NOAA SPACECRAFT
Robert L. Brower, Hilda S. Gohrband, William G. Pichel, T. L. Signore, and Charles C. Walton Jun. 1976 84 p refs
(PB-258026/4; NOAA-TM-NESS-78; NOAA-76062401) Avail: NTIS HC A05/MF A01 CSCL 08J

Sea surface temperature values were derived from scanning radiometer infrared data from the NOAA series of polar orbiting satellites. The technique used to obtain these temperatures was the fully automated computer procedure, GOSSTCOMP (Global Operational Sea Surface Temperature Computation). Surface temperature retrievals were derived by statistical analysis and quality control techniques applied to instrument measurements covering roughly 100-km. square areas. Retrieval temperatures were corrected for the effects of atmospheric attenuation by using time-coincident measurements derived from a vertical temperature profile radiometer. The basic product obtained was a daily set of 5,000 to 7,000 observations of sea surface temperature over the oceans of both hemispheres. GRA

N77-15605# National Oceanographic Data Center, Washington, D.C.
COMPUTER PROGRAMS IN MARINE SCIENCE Key to Oceanographic Records Documentation No. 5
Mary A. Firestone Apr. 1976 236 p refs
(PB-258082/7; NOAA-76062212) Avail: NTIS HC A11/MF A01 CSCL 08J

Abstracts of 700 international computer programs related to oceanography and marine engineering are presented. The data were supplied by 80 institutions in 10 countries. The document is presented to update a 1970 compilation. Author (GRA)

N77-15606# National Oceanic and Atmospheric Administration, Rockville, Md. Office of Manned Undersea Science and Technology.
MANNED UNDERSEA SCIENCE AND TECHNOLOGY FISCAL YEAR 1975 REPORT
May 1976 62 p
(PB-257994/4; NOAA-76070101) Avail: NTIS HC A04/MF A01 CSCL 06K

The program was directly involved in fostering those manned underwater scientific investigations that meet the needs and requirements of NOAA and encouraged studies that may increase the safety and versatility of manned undersea operations. GRA

N77-15607# RAND Corp., Santa Monica, Calif.
SOME PROBLEMS IN THE SIMULATION OF VERY LARGE HYDRODYNAMIC SYSTEMS
A. B. Nelson Dec. 1975 16 p
(AD-A026648; P-5552) Avail: NTIS HC A02/MF A01 CSCL 20/4

Large scale continuous simulation systems place greater demands on computer resources than most computer applications. The need for extremely large amounts of high speed core and Central Processing Unit time can tax even the largest and fastest machines. In addition, the high cost of each simulation experiment places a great responsibility on the people involved in the design, implementation and use of such systems. This paper describes approaches to dealing with the difficulties inherent to the operation of several simulation programs including both 2-D and 3-D estuary models (used for the study of tidal dynamics and water quality) and global models of ocean and atmospheric circulation. The computer requirements are discussed as well as some of the data management problems. Various procedures for simplifying the use of the programs and for validating and analyzing simulation results are considered, including graphic display. Author (GRA)

N77-15608# Woods Hole Oceanographic Institution, Mass.
DEVELOPMENT OF AN ACOUSTIC PROBE FOR DETAILED OCEAN BOTTOM AND SUB-BOTTOM SURVEYS
Willard Dow Apr. 1976 18 p refs
(Contract ERDA-11-2440; Grant NOAA-04-4-158-8)
(PB-258459/7; WHOI-76-35; NOAA-76071203) Avail: NTIS HC A02/MF A01 CSCL 08J

The development of an acoustic probe designed to resolve fine details of bottom and sub-bottom sediment layering particularly in deep water where ship sounders are usually inadequate was outlined. Penetration depths range from 12 to 72 meters and resolution approaches 15 cms. The instrument consists of a small but high powered short pulse echo sounder operating at 12 kHz and designed to be lowered on 1/4 inch diameter single conductor logging cable to a maximum water depth of 6200 meters. This unit is self-contained and battery operated. GRA

51 LIFE SCIENCES (GENERAL)

Includes genetics.

N77-15609 Michigan State Univ., East Lansing.
BLUE-GREEN ALGAL (ANABAENA FLOS-AQUAE) PROTEIN AS HUMAN FOOD Ph.D Thesis
Young Rack Choi 1976 154 p
Avail: Univ. Microfilms Order No. 76-27083

The blue-green algae Anabaena flos-aquae was grown at 32 C both in an autotrophic medium (control) without nitrogen and in a heterotrophic medium containing the following levels of additives: urea (0.01% w/v), $NaNO_3$ (0.01%), $NaNO_2$ (0.01%), peptone (0.05%), glucose (1%), and glucose plus urea (0.02% each). With glucose alone however, the blue-green algae showed good heterotrophic growth with increased yield. Changes in the concentration of glucose above or below 1% resulted in decreased yield. The theoretical yield and optimum harvesting rate of the cells were calculated on the basis of an equation from the growth curve. It was found that the green color of the algae was removed completely by illuminating with 15,064 lux fluorescent light for 8 hours at 32 C (algal suspension of 50 mg/100 ml). It was found that the highest yield of protein was obtained by the HCl-pretreatment method. Colorless and odorless protein could easily be obtained by photolyzing the protein extract after HCl-pretreatment. Dissert. Abstr.

N77-15610*# Scientific Translation Service, Santa Barbara, Calif.
STERILIZATION BY IONIZING RADIATION
M. J. Transy and J. Fleurette Jan. 1977 29 p refs Transl. into ENGLISH from Rev. D'Epidemiologie, Med. Sociale et Sante - Publique (France), vol. 24, no. 2, 1976 p 165-184
(Contract NASw-2791)
(NASA-TT-F-17514) Avail: NTIS HC A03/MF A01 CSCL 06R

The general characteristics of ionizing radiation and their activity on microorganisms are summarized showing lethal and mutagenic effects, sensitivity conditions. Different microbial species have different sensitivities: gram negative bacteria are more sensitive (D10 approximately 5-10 Krads); bacterial spores and viruses are more resistant (D10 approximately 1 Megarads. The main applications of radiosterilization are considered showing some are in full development (medical and surgical disposal equipment); others are still at the experimental stage. Practical aspects, determination of sterilizing doses and control of radiosterilization are also described. Author

N77-15611# IIT Research Inst., Chicago, Ill.
SANGUINE/SEAFARER EXTREMELY LOW FREQUENCY ELECTROMAGNETIC FIELDS: EFFECT OF LONG-TERM EXPOSURE ON SOIL ARTHROPODS IN NATURE
Bernard Greenberg (Illinois Univ., Chicago) Jul. 1976 45 p refs
(Contract N00039-73-C-0030)
(AD-A027513) Avail: NTIS HC A03/MF A01 CSCL 06/18

A study of the long-term biological impact of extremely low frequency (ELF) non-ionizing electromagnetic radiation was continued at the Navy's Wisconsin Test Facility. Population analyses of soil arthropods and a floral survey were performed on nine exposed and six control plots. Comparisons with floral surveys taken three or four years earlier suggest normal vegetational changes and succession in exposed plots and environs. Phenomena observed in the exposed and control plots are of a shared nature and thus tend to exclude an ELF electromagnetic radiation effect. Data observed to date do not support the hypothesis that low-level non-ionizing ELF electromagnetic fields have had a demonstrable impact on populations of soil arthropods and surrounding flora after six years of exposure. Author (GRA)

52 AEROSPACE MEDICINE

Includes physiological factors, biological effects of radiation; and weightlessness.

N77-15612 California Univ., Los Angeles.
AN ANALYSIS OF BRAIN SYSTEMS INVOLVED IN INITIATION OF MOVEMENT Ph.D. Thesis
Edward Joseph Neafsey 1976 126 p
Avail: Univ. Microfilms Order No. 76-28574

The firing pattern of single units in the pericruciate cortex, globus pallidus, entopeduncular nucleus, and ventral thalamus of cats was studied before and during self-initiated limb movements. The probable existence of two time-separated processes which are called set and go were examined. During the set process (defined temporally as neural activity preceding the bar pressing movement by more than 500 msec), the data indicates involvement of the globus pallidus, entopeduncular nucleus, ventrolateral-ventroanterior nuclei of the thalamus (VL-VA) and the pericruciate cortex medial to the end of the cruciate sulcus. Closer to the onset of the movement (defined by EMG activity as well as movement of the bar), the go process also involves the globus pallidus, entopeduncular nucleus, VL-VA, and medial pericruciate cortex but in addition particularly involves the pericruciate cortex lateral to the end of the cruciate sulcus. Dissert. Abstr.

N77-15613 Wisconsin Univ., Madison.
THE NEURAL CONTROL OF SKELETAL MUSCLE FIBER TYPE Ph.D. Thesis
Donald Harold Beerman 1976 164 p
Avail: Univ. Microfilms Order No. 76-20882

The strength and nature of the neural control of histochemical fiber type in porcine skeletal muscle were studied in normal adult semitendinosus, after experimental denervation and reinnervation, and in developing fetal porcine muscle. A combined silver and acetylcholinesterase method was developed for simultaneous staining of the axons and motor end plates in thick fresh frozen muscle sections. Denervation caused muscle fibers to become more homogeneous histochemically. Reinnervation occurred via extensive collateral branching of subterminal axons which gave rise to innervation of up to 15 muscle fibers by a single subterminal axon. Transformation of the histochemical profile of muscle fibers followed morphological reinnervation. A pattern of fiber type grouping unlike that observed in normal porcine muscle resulted from denervation and subsequent reinnervation. Dissert. Abstr.

N77-15614 Arizona Univ., Tucson.
NEUROTROPHIC CONTROL OF MAMMALIAN SKELETAL MUSCLE: THE ROLE OF SUBMECHANICAL THRESHOLD BIOELECTRIC ACTIVITY Ph.D. Thesis
Neal James Baumbach 1976 116 p
Avail: Univ. Microfilms Order No. 76-28224

The hypothesis that muscle bioelectric activity plays an important role in the long term maintenance of muscle was tested by electrically stimulating surgically and pharmacologically denervated muscles with submechanical threshold stimuli. Extensor digitorum longus (EDL) muscles of male Sprague-Dawley rats were used. The EDL muscles of one group of animals were surgically denervated by removal of a section of the deep peroneal nerve. The muscles were then wired at the tendons for chronic, submechanical threshold stimulation. One muscle of each animal was connected to a stimulator via a mercury-filled commutator and received continuous stimulation for 4 days. The contralateral, sham muscle received no stimulation. Both muscles from each animal were removed 1 hr after cessation of stimulation and mounted in a constant temperature chamber for isometric tension recordings. Dissert. Abstr.

N77-15615 Oklahoma Univ., Norman.
LOUDNESS AND THE ACOUSTIC REFLEX Ph.D. Thesis
Margaret Ann Wylde 1976 89 p
Avail: Univ. Microfilms Order No. 76-28133

The present experiment was designed to determine if bands of noise centered at 2000 Hz and varying in bandwidth from 1 to 6300 Hz are equally loud at reflex threshold in a sample of normal listeners. Two different approaches were used in an attempt to answer the experimental question. The first approach, the more direct measure, involved the determination of the relative loudness of stimuli at reflex threshold by loudness balancing each band of noise at reflex threshold level with a 200 Hz comparison sinusoid. If the bands were all equally loud at reflex threshold level it was expected that the SPL of the comparison signal would be constant. The second approach involved an indirect assessment of the relative loudness of stimuli at reflex threshold intensities by generating equal loudness contours by loudness balancing the noise bands which were varied in intensity

with a 2000 Hz reference sinusoid at 70, 80, 90 and 100 dB SPL. Dissert. Abstr.

N77-15616 Wisconsin Univ., Madison.
MEASURING PUPILLARY AND VISUAL TEMPORAL FUNCTIONS USING A NEW PUPILLOMETER-STIMULATOR Ph.D. Thesis
Sherman Lee Heller 1976 151 p
Avail: Univ. Microfilms Order No. 76-20896

A pupillometer-eye tracking facility was developed to provide accurate measurements of pupillary diameter and to track pursuit and saccadic eye movements. The self-contained facility was linked to a SDS 930 computer for both control of test stimuli and analysis of data. The sensor was a non-storage image dissector tube which prevented smearing of the pupil image from inadevertent eye motion and permitted high speed eye movement tracking. Pupil diamoter accuracy was about 0.05 mm with a frequency response of 15 Hz. Eye movement frequency response was about 60 Hz (updated approximately every 8 ms) with an accuracy of 1/2 deg over a 20 deg field of view. Normal saccadic eye movements of 30 to 40 ms duration were easily followed. For investigating the temporal characteristics of visual perception or the pupillary light reflex, flexible, accurate, and stable light stimulator was developed. Dissert. Abstr.

N77-15617*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
MAGNETIC ELECTRICAL CONNECTORS FOR BIOMEDICAL PERCUTANEOUS IMPLANTS Patent Application
Lester J. Owens, inventor (to NASA) Filed 30 Jul. 1976 14 p
(NASA-Case-KSC-11030-1; US-Patent-Appl-SN-709849) Avail: NTIS HC A02/MF A01 CSCL 06B

A biomedical percutaneous connector for providing electrical connection between electrical conductors carried externally of a patient's body, and electrical conductors implanted within the body of the patient is described. The connector includes a socket having an enlarged disk shaped base portion for being implanted below the patient's skin. A cylindrical portion is integral with the base portion and extends outwardly of the skin. A conical recess is provided in a upper end of the cylindrical portion and has a magnet located in the base. Inclined conductive strips are carried on an upper end of the cylindrical portion adjacent the conical recess to which electrical conductors are attached and extend into the patient's body. A complementary shaped plug which also has electrical contacts provided is adaped to fit within the conical recess of the socket. NASA

N77-15618*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
ROTATIONAL JOINT FOR THE PROSTHETIC LEG Patent Application
Lester J. Owens and William C. Jones, inventors (to NASA) Filed 30 Jul. 1976 14 p
(NASA-Case-KSC-11004-1; US-Patent-Appl-SN-710032) Avail: NTIS HC A02/MF A01 CSCL 06B

A rotational joint assembly for a prosthetic leg which enables an artificial foot to rotate slighly when a person is walking, running or turning is described. The prosthetic leg includes upper and lower tubular members with the rotational joint assembly interposed therebetween. The rotational joint assembly includes a restrainer mechanism which consists of a pivotably mounted paddle element engaging a resilient device for applying a limiting force to control the rotation of the foot and also restoring torque to return the foot back to its initial position. NASA

N77-15619*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EKG AND ULTRASONOSCOPE DISPLAY Patent Application
Robert D. Lee, inventor (to NASA) Filed 17 Jan. 1977 21 p
(NASA-Case-ARC-10994-2; US-Patent-Appl-SN-759965) Avail: NTIS HC A02/MF A01 CSCL 06B

A system is disclosed which permits simultaneous display of an EKG waveform in real time in conjunction with a two dimensional cross sectional image of the heart, so that the EKG waveform can be directly compared with dimensional changes in the heart. The apparatus of the invention includes an ultrasonoscope for producing a C-scan cross-sectional image of the heart. An EKG monitor circuit along with EKG logic circuitry is combined with the ultrasonoscope circuitry to produce on the same oscilloscope screen a continuous vertical trace showing the EKG waveform simultaneously with the heart image. The logic circuitry controls the oscilloscope display such that the display of both heart and EKG waveforms occurs on a real time basis. NASA

N77-15620*# Texas Technological Univ., Lubbock. School of Medicine.
INTERNATIONAL CONFERENCE ON REMOTE EMERGENCY MEDICAL SERVICES
15 May 1975 198 p refs Conf. held at Lubbock, Tex., 15-17 May 1975
(Contract NAS9-14438)
(NASA-CR-151154) Avail: NTIS HC A09/MF A01 CSCL 06E

An emergency medical system is characterized. Applications of NASA technology in biomedical telecommunication and bioinstrumentation are explored. The training and effectiveness of paramedics, technicians, nurses, and physicians are evaluated as applied to emergency situations and the operations of trauma centers. Civilian and military aeromedical evacuation is discussed. A.H.

N77-15621*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A MINIATURE IMPLANTABLE ULTRASONIC ECHOSONOMETER Patent Application
Gilbert K. Kojima, inventor (to NASA) Filed 12 Jan. 1977 14 p
(NASA-Case-ARC-11035-1; US-Patent-Appl-SN-758721) Avail: NTIS HC A02/MF A01 CSCL 06B

A miniature echosonometer adapted for implantation in the interior of an animal for imaging the internal structure of an organ, tissue or vessel is described. The echosonometer includes a receiver/transmitter circuit which is coupled to an ultrasonic transducer. Power is coupled to the echosonometer by electromagnetic induction through the animal's skin. Imaging signals from the echosonometer are electronmagnetically transmitted through the animal's skin to an external readout apparatus. NASA

N77-15622# Mayo Foundation, Rochester, Minn. Dept. of Physiology and Biophysics.
PROTECTION OF THE CARDIOPULMONARY SYSTEMS AGAINST THE INJURIOUS EFFECTS OF ACCELERATION Annual Progress Report, 1 Jul. 1974 - 30 Jun. 1976
Peter A. Chevalier Jun. 1975 37 p refs
(Contract F44620-71-C-0069; AF Proj. 6813)
(AD-A027715; AFOSR-76-0689TR) Avail: NTIS HC A03/MF A01 CSCL 06/19

Research accomplished during the period centered primarily on the application of recently developed pulmonary parenchymal markers and three-dimensional transaxial reconstruction techniques to the study of the spatial distribution of lung parenchymal strains, regional lung volumes and lung geometry. The development of these marker techniques provide a unique research tool. The data described in this report represent significant new information regarding regional mechanical properties of the lung and clearly indicate the need to study the intrinsic elastic behavior in order to quantitate dynamic changes. GRA

N77-15623# Office of Naval Research, London (England).
WORKSHOP ON THE TREATMENT OF DECOMPRESSION SICKNESS
K. M. Greene 12 Jul. 1976 9 p Workshop held at London, 17-18 Feb. 1976
(AD-A027626; ONRL-C-18-76) Avail: NTIS HC A02/MF A01 CSCL 06/19

This report summarizes a workshop held 17-18 February 1976 in London. The thirty physicians attending from seven nations sought a uniform approach to the treatment of decompression sickness in the North Sea environment. Aspects considered include recompression profiles, gas mixtures, ancillary drugs, aftercare, qualification of assistants, and communication problems. Included in the report is an outline approved by the EUBS for guidance in the choice of treatment tables. Author (GRA)

N77-15624# Hawaii Univ., Honolulu. Dept. of Physiology.
QUANTIFICATION OF HEAT LOSS FROM VARIOUS ROUTES IN MAN DWELLING IN A WET/DRY HYPERBARIC ENVIRONMENT Ph.D. Thesis. Final Report, 1 May 1972 - 31 Aug. 1975
Terence O. Moore and James F. Morlock 1 Jun. 1976 217 p refs
(Contract N00014-67-A-0387-0016; NR Proj. 101-941)
(AD-A027592) Avail: NTIS HC A10/MF A01 CSCL 06/19

Respiratory and whole body heat losses have been quantified and predictive equations have been derived for diving conditions of depth, gas density, gas mix, ambient and immersion water temperatures, and work levels. GRA

N77-15625# Army Materiel Command, Texarkana, Tex. Intern Training Center.
A STUDY OF THE EFFECT OF CONTROLLED EXERCISE ON PERFORMANCE DURING STRESSFUL CONDITIONS Final Report
Kenneth E. Moseley Dec. 1975 47 p refs Prepared in cooperation with Texas A and M Univ., Texarkana
(AD-A026350; USAMC-ITC-02-08-76-419) Avail: NTIS HC A03/MF A01 CSCL 06/19

This paper reports the results of an experiment designed to prove or disprove the theory that controlled exercise during extreme stress could significantly reduce fatigue. The nature of mental fatigue is thoroughly discussed as well as many of the factors which cause this condition. The experiment was constructed from a statistics final examination. Two statistics classes were divided into three randomized sections, each receiving a different activity treatment level. Section three was given a seven minute exercise period, Section two was given a seven minute rest period, and Section one was given no rest and immediately began work on the second portion of the exam. Analytical results showed no difference in the mean scores of the three sections. This leads to the conclusion that controlled exercise does not have an effect on performance. A discussion of 'blocking' is presented as an explanation of the results. Experimental design and related topics are presented for further research.
Author (GRA)

N77-15626# Army Materiel Command, Texarkana, Tex. Intern Training Center.
USE OF KIRLIAN PHOTOGRAPHY IN FATIGUE ASSESSMENT Final Report
C. Thomas Reeves Dec. 1975 59 p refs
(AD-A026349; USAMC-ITC-02-06-76-403) Avail: NTIS HC A04/MF A01 CSCL 06/19

In this research, assessment of fatigue by using Kirlian photography was investigated. Both mental and physical fatigue were included in the study. The mental stressor used was engineering graduate school class lectures; the physical stressor was softball games played under hot, humid atmospheric conditions. The photograph parameter used to indicate fatigue was the fingertip's corona diameter. A Wilcoxon signed rank test at the 0.99 level of significance determined statistically significant corona diameter changes did occur in both cases. The diameter significantly increased after applying the physical stressor and decreased after applying the mental stressor.
Author (GRA)

N77-15627# Edgewood Arsenal, Aberdeen Proving Ground, Md.
CHOLINERGIC SYSTEMS IN BRAIN MEDIATING THERMOREGULATORY FUNCTION: A REVIEW
Thomas A. Rudy and Tony L. Yaksh Jun. 1976 36 p refs
(DA Proj. 1W7-62718-AD-21)
(AD-A026948; EB-SP-76014) Avail: NTIS HC A03/MF A01 CSCL 06/16

The report consists of a comprehensive review of the literature pertaining to the involvement in thermoregulatory function of cholinergic systems in the brain. The literature surveyed includes that published prior to November 1974. The review is organized into subsections, each devoted to data derived from a particular mammalian species (mouse, rat, cat, rabbit, goat, sheep, rhesus monkey, man). Emphasis is placed upon evidence arising from use of the intracerebro-ventricular and intracerebral routes of drug administration, although results based on the systemic administration of centrally active modifiers of cholinergic function are also considered. The experimental findings discussed most extensively are those illustrating cholinergically mediated effects on deep body temperature, on the 'setpoint' for thermoregulation, and on the state of activation of individual peripheral effector mechanisms mediating heat gain and heat loss. GRA

N77-15628# Mount Sinai Medical Center, Miami Beach, Fla. Div. of Pulmonary Diseases.
DETECTION AND PREVENTION OF G-INDUCED REGIONAL ATELECTASIS, EDEMA, AND HYPOPERFUSION Final Report, Oct. 1971 - Oct. 1973
Marvin A. Sackner and Adam Wanner Dec. 1975 268 p refs
(Contract F41609-72-C-0004; AF Proj. 7930)
(AD-A026238; SAM-TR-75-25) Avail: NTIS HC A12/MF A01 CSCL 06/19

These investigations were concerned with the evaluation of pulmonary circulation and the distribution of ventilation in response to maneuvering acceleration. In order to study the response of -Gz protection by the anti-G suit, respiratory maneuvers, and pharmacologic agents, it was necessary to improve existing methods and to develop new ones--both in anesthetized dogs and in human volunteers. To standardize noninvasive tests of the pulmonary circulation and distribution of ventilation, invasive studies were necessarily performed on anesthetized animals for comparison. One of the studies which dealt with the action of anti-G suits led to the hypothesis that anti-G suits would be more efficient if they inflated from below, upward (rather than from the abdominal bladder, downward, as in the standard USAF anti-G suit). GRA

N77-15629# Union Carbide Corp., Bound Brook, N.J. Dept. of Chemicals and Plastics.
MICROFIBER MATERIALS FOR GROWTH OF INTIMAL LININGS IN CIRCULATORY ASSIST DEVICES Annual Technical Progress Report, Jun. 1975 - Mar. 1976
William F. Beach and Frederick R. Tittmann 30 Mar. 1976 25 p refs
(Contract NO1-HV-1388)
(PB-257846/6; NIH-NO1-HV-8-1388-A5) Avail: NTIS HC A02/MF A01 CSCL 06L

Research efforts on the development of microfiber scaffolding for the in-growth of neointimal tissue to achieve blood compatibility with the internal surfaces of circulatory assist device parts are presented. The production of microfiber lined Tecothane axisymmetric Model X blood pump bladders, for use by evaluators is studied. While the principal bladder lining approach has continued to involve eversion and the use of an additional adhesive, it was necessary to develop a microfiber lining type, as it was realized that type E would not promote a suitable level of cellular adhesion of the neointimal tissue. GRA

N77-15630# Union Carbide Corp., Bound Brook, N.J. Dept. of Research and Development.
DEVELOPMENT OF IMPROVED MATERIALS FOR EXTRAORAL MAXILLOFACIAL PROSTHESIS Comprehensive Annual Technical Report, 1 Jun. 1975 - 1 Jun. 1976
Lloyd M. Robeson, Winfred J. Saunders, and Markus Matzner Jun. 1976 48 p refs
(Contract NO1-DE-42436)
(PB-257860/7; NIDR/CR-76/10; CATR-1) Avail: NTIS HC A03/MF A01 CSCL 06L

The development of improved materials for extraoral maxillofacial prosthesis is reported. Fabrication problems were observed and studied. Vacuum molding and emulsion casting techniques were developed but were found to be inferior to solution casting techniques. The composite of C-4 polycarbonate/silicone rubber prosthesis skins with silicone rubber foam as the interior yielded lightweight tough prosthesis. Relative to RTV silicone rubber, the fabrication route for the product defined is considerably more difficult, and shrinkage problems exist with larger moldings. The fabrication difficulty was considered serious enough such that clinical evaluations were not initiated. Color illustrations are reproduced in black and white. GRA

N77-15631# Thermo Electron Corp., Waltham, Mass.
VAPOR CYCLE ENERGY SYSTEM FOR IMPLANTABLE CIRCULATORY ASSIST DEVICES Annual Progress Report, Jul. 1975 - May 1976

R. P. Watelet, A. E. Ruggles, and K. G. Hagen May 1976 294 p refs
(Contract N01-HV-4-2909)
(PB-257751/8; TE-4182-94-76; NIH-N01-HV-4-2909-3) Avail: NTIS HC A13/MF A01 CSCL 06L

The development status of a heart assist system driven by a nuclear fueled, electronically controlled vapor cycle engine termed the tidal regenerator engine (TRE) was described. The TRE pressurization was controlled by a torque motor coupled to a displacer. The electrical power for the sensor, electronic logic and actuator was provided by thermoelectric modules interposed between the engine superheater and boiler. The TRE was direct coupled to an assist blood pump which also acted as a blood-cooled heat exchanger, pressure-volume transformer and sensor for the electronic logic. Engine cycle efficiency in excess of 14 % was demonstrated routinely. GRA

N77-15632# Thermo Electron Corp., Waltham, Mass.
FABRICATION OF IMPLANTABLE ARTIFICIAL HEART DEVICES AND COMPONENTS Annual Technical Progress Report, Apr. 1975 - Mar. 1976
J. Keiser and V. Poirier Mar. 1976 44 p
(Contract N01-HV-1-2065)
(PB-257845/8; TE-4143-78-76; NIH/NHLI-71-2065-5) Avail: NTIS HC A03/MF A01 CSCL 06L

During the past year, axisymmetric blood pumps, pusher plate pumps, pump control systems and mock circulatory loop components were fabricated. Fabrication and test of a standardized mock circulatory loop was carried out; this system provides a standard circulatory analog for comparative testing of assist pumps and related devices. It includes a mock ventricle which simulates the natural heart function allowing for dynamic analysis of device performance. GRA

N77-15633# Southern Research Inst., Birmingham, Ala.
DEVELOPMENT OF IMPROVED MATERIALS FOR EXTRA-ORAL MAXILLOFACIAL PROSTHESES Annual Technical Report No. 2, 15 May 1975 - 15 May 1976
Danny H. Lewis, David R. Miller, and Donald R. Cowsar Jun. 1976 48 p refs
(Contract N01-DE-42435)
(PB-258002/5; SORI-EAS-76-251; NIDR/CR-76/11) Avail: NTIS HC A03/MF A01 CSCL 06L

An improved elastomer with an optimum balance of mechanical properties, processability, environmental stability, colorability, and esthetics, for use in fabricating extraoral maxillofacial prostheses, was sought. An arylene silicone polymer polytetramethylsilphenylene-siloxanedimethylsiloxane was synthesized and formulated as a pourable, viscous, room-temperature-vulcanizing liquid. GRA

N77-15634# Office of Radiation Programs, Washington, D.C. Environmental Analysis Div.
A MEASUREMENT OF RF FIELD INTENSITIES IN THE IMMEDIATE VICINITY OF AN FM BROADCAST STATION ANTENNA
R. A. Tell Jan. 1976 13 p refs Sponsored by EPA
(PB-257698/1; ORP/EAD-76-2) Avail: NTIS HC A02/MF A01 CSCL 06R

An FM broadcast tower was surveyed to determine the radiofrequency exposure levels to which personnel working on such towers would be exposed during such tasks as painting, beacon replacement, repairs to de-icing equipment, antenna adjustment, and tower rigging and replacement. High intensity radiofrequency fields in excess of 180 mW/SQ cm were found on the tower. To prevent a worker's exposure from exceeding OSHA standards, he would be allowed to work in this field only 20 seconds in each 6 minute period. Since this is impractical, it was suggested that tower work be performed only when the transmitter is turned off. GRA

N77-15635# Nuclear Regulatory Commission, Washington, D.C. Office of Standards Development.
MANUAL OF RESPIRATORY PROTECTION AGAINST AIRBORNE RADIOACTIVE MATERIALS Final Report
Jerrold L. Caplin , Bruce J. Held , Robert J. Catlin , Darell A. Bevis (Los Alamos Sci. Lab., N. Mex.), Evan Campbell (Los Alamos Sci. Lab., N. Mex.), Harry J. Ettinger (Los Alamos Sci. Lab., N. Mex.), Louis A. Geoffrion (Los Alamos Sci. Lab., N. Mex.), Alan L. Hack (Los Alamos Sci. Lab., N. Mex.), Edwin C. Hyatt (Los Alamos Sci. Lab., N. Mex.), John C. Pritchard (Los Alamos Sci. Lab., N. Mex.) et al Oct. 1976 147 p refs
(PB-258052/0; NUREG-0041) Avail: NTIS HC A07/MF A01 CSCL 06Q

The manual provides broad guidance for the planned use of respirators to protect individuals from airborne radioactive materials that might be encountered during certain operations. The guidance is intended for use by management in establishing and supervising programs and by operating personnel in implementing programs. Guidance is primarily directed to the use of respirators to prevent the inhalation of airborne radioactive materials. Author

N77-15636# McDonnell-Douglas Astronautics Co., Richland, Wash. Energy Lab.
IMPLANTED ENERGY CONVERSION SYSTEM Annual Report, 1 May 1975 - 1 Jun. 1976
R. P. Johnston, L. P. Bakker, A. Bennett, C. R. Blair, S. G. Emigh, G. M. Eglesby, D. H. Gray, W. R. Griffith, J. E. Noble, J. F. Oster et al Aug. 1976 255 p refs
(Contract N01-HV-4-2901)
(PB-257888/8; MDC-G4448; NIH-N01-HV-4-2901-3) Avail: NTIS HC A12/MF A01 CSCL 06L

The heart power source combines the high efficiency of Stirling engines with the reliability, efficiency, and flexibility of hydraulic power transfer and control to ensure long system life and physiological effectiveness. Extended life testing was achieved with an engine (1.57 years) and hydraulic actuator/controller (1.07 years) in continuing tests without failure. Animal in-vivo tests with an assist heart consistently demonstrated required performance by biological synchronization and effective ventricle relief. Carefully planned development of System 6 produced major reductions in required input power and size. Author

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N77-15637*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WHY MAN EXPLORES
1976 44 p refs Symp. held at Pasadena, Calif., 2 Jul. 1976
(NASA-EP-125) Avail: NTIS HC A03/MF A01 CSCL 05J

This NASA Educational Publication was prepared from a transcript of a panel discussion held on July 2, 1976, in conjunction with the Viking Missions to Mars. The members of the Why Man Explores panel were selected as authorities in classical disciplines relating to exploration. Author

N77-15638# Oregon Univ., Eugene. Dept. of Psychology.
CODING SYSTEMS AND THE COMPREHENSION OF INSTRUCTIONAL MATERIALS Semiannual, Technical Report, 1 Nov. 1974 - 30 Apr. 1975
Ray Hyman Apr. 1975 47 p refs
(Contract F44620-73-C-0056; ARPA Order 2448; AF Proj. 6813)
(AD-A026361; AFOSR-76-0180TR) Avail: NTIS HC A03/MF A01 CSCL 05/10

This research continues earlier studies of how learners encode information for storage in memory and the effect of the encoding process on retrieval from memory storage. Current research is extending the investigation to the storage and recovery of semantic (meaningful) information rather than unrelated units of information. The writer and his associates are working on the process of 'chunking' information into units as an influence on memory. They are also investigating the differences in encoding that characterize sophisticated learners as compared to novice in a subject matter field; and they are performing studies of memory in the mode of classical and semantic memory formulations. GRA

N77-15639# Air Force Human Resources Lab., Brooks AFB, Tex.
COGNITIVE PRETRAINING OF THE T-37 OVERHEAD TRAFFIC PATTERN Final Report, May 1974 - Jun. 1975
Bruce A. Smith, Brian K. Waters, and Bernell J. Edwards Dec. 1975 55 p refs
(AF Proj. 1123)
(AD-A026118; AFHRL-TR-75-72) Avail: NTIS HC A04/MF A01 CSCL 05/9

This study investigated the utility of a cognitive pretraining instructional package to the training of the T-37 overhead traffic pattern used in Air Force undergraduate pilot training (UPT). A multi-media package was prepared following instructional systems development (ISD) procedures. The package included a programmed text, sound/slide briefing, 8mm motion picture sequence and a 49 item multiple-choice criterion measure. Instructional material was validated using three UPT classes at Williams AFB, Arizona. An evaluation of the effectiveness of the instructional package was performed using two student sections from class 76-05 (n=15 each) as experimental (E) and control (C) groups. Criterion test scores and inflight T-37 instructor pilot rated performance were used as dependent variables. Results showed consistent, significantly better student performance on all measures by E, particularly in early training. Overall, the instructional program significantly improved the student pilot's recognition of critical cues, increased student knowledge, confidence, and coordination as rated by the instructor pilots, and resulted in an average of two less flights per subject to attain criterion performance on the task. The authors recommend implementation of the cognitive pretraining package into the UPT curriculum throughout Air Training Command (ATC) and that ATC apply the concept of cognitive pretraining in the development of curriculum to train other complex psychomotor tasks. The technique appears to be both efficient and cost-effective.
Author (GRA)

N77-15640# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
HUMAN FACTORS OF DOT MATRIX DISPLAYS Final Technical Report, Feb. 1973 - Oct. 1974
Gregory L. Peters and Terry M. Riley (Bunker-Ramo Corp., Silver Spring, Md.) Feb. 1976 82 p
(AF Proj. 2020)
(AD-A026244; AFFDL-TR-75-48) Avail: NTIS HC A04/MF A01 CSCL 05/5

The document presents a series of reports given at a meeting on the Human Factors of Dot Matrix Displays held at the Flight Dynamics Laboratory. The main presentations were intermediate reports by two prime contractors performing dot matrix legibility studies and a third primary contractor constructing a Light Emitting Diode (LED) display simulator. Reports of several in-house activities were also given by Flight Dynamics Laboratory, Aerospace Medical Research Laboratory and Army Electronics Command personnel.
Author (GRA)

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N77-15641*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SPACESUIT MOBILITY JOINTS Patent Application
Hubert C. Vykukal, inventor (to NASA) Filed 23 Dec. 1976 47 p
(NASA-Case-ARC-11058-1; US-Patent-Appl-SN-753965) Avail: NTIS HC A02/MF A01 CSCL 05H

Constant volume mobility joints are described for interconnecting adjacent segments of an hermetically sealed spacesuit for relative motion. Each joint includes at least one pair of annuli supported for pivotal displacement about paralleling axes and a flexible, substantially impermeable diaphragm of a tubular configuration spanning the distance between the annuli and connected thereto in an hermetically sealed relationship therewith. The diaphragm includes at least one rolling convolution having a crown disposed in a fixed relation with an axis about which one of the annuli pivots.
NASA

N77-15642*# Kanner (Leo) Associates, Redwood City, Calif.
A NEW HEAD-UP CONTROL DISPLAY: MEDICO-PHYSIOLOGICAL CONSIDERATIONS
J. Lavernhe Washington NASA Jan. 1977 19 p Transl. into ENGLISH from Revue de Medecine Aeronautique et Spatiale (France), no. 53, 1975 p 37-43
(Contract NASw-2790)
(NASA-TT-F-17387) Avail: NTIS HC A02/MF A01 CSCL 05E

The advantages of a head up flight control display with speed vector are discussed, particularly with regard to the time saved because of the fewer number of flight parameters involved in the maneuvers considered (approach and landing) and because the display obviates the need for constant sequential monitoring of the instrument panel.
Author

N77-15643*# Hamilton Standard Div., United Aircraft Corp., Windsor Locks, Conn.
HOLLOW FIBER MEMBRANE SYSTEMS FOR ADVANCED LIFE SUPPORT SYSTEMS Final Report
George J. Roebelen, Jr. and Michael J. Lysaght Oct. 1976 255 p refs
(Contract NAS9-14682)
(NASA-CR-151149; SVHSER-7100) Avail: NTIS HC A12/MF A01 CSCL 06K

The practicability of utilizing hollow fiber membranes in vehicular and portable life support system applications is described. A preliminary screening of potential advanced life support applications resulted in the selection of five applications for feasibility study and testing. As a result of the feasibility study and testing, three applications, heat rejection, deaeration, and bacteria filtration, were chosen for breadboard development testing; breadboard hardware was manufactured and tested, and the physical properties of the hollow fiber membrane assemblies are characterized.
Author

N77-15644*# Martin Marietta Corp., Denver, Colo.
A TRADEOFF STUDY TO DETERMINE THE OPTIMUM APPROACH TO A WASH/RINSE CAPABILITY TO SUPPORT FUTURE SPACE FLIGHT Final Report
D. A. Wilson Dec. 1976 194 p refs
(Contract NAS9-15102)
(NASA-CR-151155; MCR-76-561; DRL-T-1302; DRD-MA-646T) Avail: NTIS CSCL 06K

Specific requirements for a wash/rinse capability to support Spacelab biological experimentation and to identify various concepts for achieving this capability were determined. This included the examination of current state-of-the-art and emerging technology designs that would meet the wash/rinse requirements. Once several concepts were identified, including the disposable utensils, tools and gloves or other possible alternatives, a tradeoff analysis involving system cost, weight, volume utilization, functional performance, maintainability, reliability, power utilization, safety, complexity, etc., was performed so as to determine an optimum approach for achieving a wash/rinse capability to support future space flights. Missions of varying crew size and durations were considered.
Author

N77-15645*# Minnesota Univ., St. Paul. Dept. of Food Service and Nutrition.
STORAGE STABILITY AND IMPROVEMENT OF INTERMEDIATE MOISTURE FOODS, PHASE 4 Final Report, Sep. 1975 - Sep. 1976
Theodore P. Labuza Sep. 1976 385 p refs
(Contract NAS9-12560)
(NASA-CR-151147) Avail: NTIS HC A17/MF A01 CSCL 06H

Shelf life tests are used to estimate the rate of nonenzymatic browning; however, controlling the reducing sugar levels below 23:1 molar ratio to amines, slows the rate. In addition, liquid glycols surpress browning. The protozoan Tetrahymena pyriformis W can be used to estimate nutrition losses during browning. At high temperatures (80 to 120 C) used in processing intermediate moisture foods (IMF), vitamin C destruction shifts to a zero order

mechanism. BHA and BHT are the most effective antioxidants against rancidity. In shelf life testing however, 45 C should be the maximum temperature used. Water binding agents are studied. The five isotherms of thirteen humectants were determined. The results show that neither the method of addition nor sequence of addition affects the a sub u lowering ability of these humectants. Results were used to formulate shelf stable IMF processed cheese foods with at least four months shelf life.
Author

N77-15646# Alberta Univ., Edmonton.
ANALYSIS OF MULTIPLE FREQUENCY FOOD PROCESSING SYSTEM Final Report, Dec. 1973 - Dec. 1974
W. R. Tinga 31 Oct. 1975 31 p refs
(Grant DAHC04-74-G-0075)
(AD-A026768; ARO-12109.1-EL) Avail: NTIS HC A03/MF A01 CSCL 06/8

A model is described for predicting temperature profiles in materials heated by microwave power at 2450 MHz and 915 MHz. Theoretical and some experimental data are given to show that internal temperatures in cylinders and spheres exposed to microwaves from all sides are considerably higher than the surface temperatures of the materials. The time dependent three-dimensional heat conduction equation including an internal heat generation term is solved for parallel slabs and infinite cylinders.
GRA

N77-15647# School of Aerospace Medicine, Brooks AFB, Tex.
BIOMEDICAL ASPECTS OF OXYGEN REGULATOR PERFORMANCE. 2: DYNAMIC CHARACTERISTICS Report, 1 Jan. - 1 Aug. 1975
Paul J. Zalesky, Ronald D. Holden, and Bruce F. Hiott 1 Aug. 1975 10 p refs
(AF Proj. 7164)
(AD-A026504; SAM-TR-75-368) Avail: NTIS HC A02/MF A01 CSCL 06/11

Several oxygen regulators were quantitatively assessed during interface with dynamic respiratory simulation and human user breathing. Continuous measurements of regulator flow, delivered pressure, and delivered oxygenation were provided during variable tidal volumes and breathing frequencies as accomplished initially with breathing simulation and subsequently with human users. The regulators demonstrated large sensitivity to flow demand and the characteristics of the inspiratory flow pulse. Large variations in outlet suction pressure and delivered oxygen concentration accompanied the variable breathing modes of human subjects. The inability of oxygen regulators to consistently provide required oxygen/air delivery is discussed with respect to inadequate performance specifications currently used.
Author (GRA)

N77-15648# School of Aerospace Medicine, Brooks AFB, Tex.
A PORTABLE OXYGEN SYSTEM FOR AEROMEDICAL CREWMEMBERS. AN EVALUATION Interim Report, Jan. - Jun. 1975
Thomas R. Morgan Apr. 1976 14 p refs
(AF Proj. 7164)
(AD-A027373; SAM-TR-76-2) Avail: NTIS HC A02/MF A01 CSCL 06/11

An emergency portable oxygen system for aeromedical crewmembers was subjected to a series of manned human compatibility tests. Test conditions included decompression to a simulated cabin altitude of 40,000 feet, with subsequent emergency descent and continuation at 25,000 feet until the system's chlorate-candle oxygen generator was exhausted. Test subjects were satisfactorily oxygenated in all cases, and the unit's external-surface and product-gas temperatures remained acceptable throughout each test. After use, however, each unit experienced melting/failure of the oxygen-mask hose at its junction with the candle assembly's oxygen-delivery tube. A modification rectifying this tendency was derived and satisfactorily tested in subsequent experiments. Problems and advantages inherent to the system's function are discussed in the light of both physiological and anticipated operational effectiveness.
Author (GRA)

N77-15649# Woods Hole Oceanographic Institution, Mass.
DESCRIPTION OF AN EXPERIMENTAL UNDERSEA MANIPULATOR SYSTEM WITH FORCE FEEDBACK Technical Report, Nov. 1974 - Nov. 1975
W. R. Bertsche, A. J. Pesch, and C. L. Winget May 1976 33 p
(Contract N00014-74-C-0179; NR Proj. 196-131)
(AD-A027436; WHOI-TM-2-76) Avail: NTIS HC A03/MF A01 CSCL 13/9

The report describes an experimental undersea manipulator system with force feedback capability. The basic system includes the means for providing alternate forms of force feedback: information to the operator, with the installation designed to simulate the undersea operating conditions of a small manned submersible.
Author (GRA)

N77-15650# Woods Hole Oceanographic Institution, Mass.
POTENTIAL DESIGN ALTERNATIVES AND ANALYSIS OF SYSTEM RESPONSE VARIABLES, CHARACTERISTIC OF UNDERSEA MANIPULATORS WITH FORCE FEEDBACK
W. R. Bertsche, A. J. Pesch, and C. L. Winget May 1976 70 p refs
(Contract N00014-74-C-0179; NR Proj. 196-131)
(AD-A027435; WHOI-TM-1-76) Avail: NTIS HC A04/MF A01 CSCL 13/9

This report concerns the examination of the engineering features which affect force feedback design and fidelity in undersea manipulators. The findings obtained from the test program provided the basis on which a series of engineering test procedures were established for use in evaluation undersea manipulators, including a set of basic definitions concerning each of the variables being measured.
Author (GRA)

N77-15651# Naval Medical Research Inst., Bethesda, Md.
ENERGY, PROTEIN, MINERAL AND WATER CONTENT OF FOOD ITEMS Medical Research Progress Report
V. Frattali, M. Quesada, and R. Robertson Apr. 1976 25 p refs
(AD-A026756; PR-8) Avail: NTIS HC A02/MF A01 CSCL 06/8

Methods used to determine the energy, protein, mineral, and water content of prepared food items that composed the diet for five divers involved in a biomedical study lasting 30 days which included nutrition in a high pressure helium-oxygen environment are described. Moisture content of food items was determined by a gravimetric procedure, energy by oxygen bomb calorimetry, nitrogen by a semimicro Kjeldahl procedure, and sodium and potassium by atomic absorption spectrophotometry. Approximately 300 food items were analyzed in order to calculate the energy, protein, mineral and water intake for the hyperbaric nutrition balance study.
GRA

N77-15652# Clarkson Coll. of Technology, Potsdam, N.Y. Dept of Mechanical and Industrial Engineering.
AN IMPROVED HUMAN DISPLAY MODEL FOR OCCUPANT CRASH SIMULATION PROGRAMS Technical Report, Jul. 1975 - Jun. 1976
K. D. Willmert and T. E. Potter (Xerox Corp., Webster, N. Y.) Apr. 1976 24 p refs
(Contract N00014-76-C-0064; NR Proj. 064-548)
(AD-A026719; MIE-018) Avail: NTIS HC A02/MF A01 CSCL 09/2

Presented is an improved three-dimensional display model of a human being which can be used to display the results of three-dimensional simulation programs that predict the positions of an occupant during impact of a vehicle. The model allows the user to view the occupant from any orientation in any position during the crash. The display model assumes the usual break up of the body into rigid segments which is normal for occupant crash simulation programs, but the shape of the segments in the display model are not necessarily the same as those used in the crash simulation. The display model is proportioned so as to produce a realistic drawing of the human body in any position. Joints connecting the segments are also drawn to improve realism.
Author (GRA)

N77-15653# Navy Clothing and Textile Research Unit, Natick, Mass.
ALUMINIZED FIREMEN'S (FIRE PROXIMITY) HANDWEAR: A COMPARATIVE STUDY OF DEXTERITY CHARACTERISTICS Technical Report, Nov. 1975 - Jun. 1976

Francis S. Andruk, James C. Shampine, and Dale A. Reins Jul. 1976 25 p refs
(AD-A027211; DOD-AGFSRS-76-17; TR-121/5-76) Avail: NTIS HC A02/MF A01 CSCL 06/17

A comparative study of the tactility and dexterity characteristics of several configurations of aluminized firemen's (fire proximity) handwear was conducted. The old standard aluminized firemen's glove was compared with that of the recently adopted two component (glove shell and glove insert) standard and a newly developed experimental prototype, which was prepared in three models (MOD-I, MOD-II and MOD-III) for this study. The manipulatory capabilities of all the gloves were measured against the ungloved or bare hand, and the results indicated that MOD-III of the new experimental prototype exceeded that of the old and new standard and came closest in performance to the ungloved hand. GRA

N77-15654# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A MEASURE OF FOVEAL SENSITIVITY IN AN EXPANDED FIELD OF VISUAL ATTENTION M.S. Thesis
Jack T. Sakai Jun. 1976 165 p refs
(AD-A026010; GE/EE/76-11) Avail: NTIS HC A08/MF A01 CSCL 05/5

The report measured the effect of a peripheral task on the foveal contrast sensitivity. The foveal sensitivity was measured while subjects were required to simultaneously concentrate on a peripheral task which was placed at eccentricities of 10 degrees, 20 degrees, and 30 degrees along the right horizontal axis. The peripheral task was a sine-wave grating which was generated on an HP-1205A oscilloscope. The foveal contrast sensitivity was measured for 4 angular orientations using 4 spatial frequencies (3, 6, 10 and 20 cycles per degree) of sine-wave gratings. All threshold measurements were obtained using the staircase method of psychophysical testing. The staircases for each of the 4 orientations were run concurrently by random selections among these orientations. All stimulus presentations were under computer control. Stimulus presentation times were 20, 50, 100, and 500 msec. The results show that with training, a subject's foveal contrast sensitivity was not affected by a peripheral task. GRA

N77-15655# Oceanautics, Inc., Landover, Md.
AN ANALYSIS OF ENVIRONMENTAL AND PERCEPTUAL DETERMINANTS OF DISPLAY LEGIBILITY UNDERWATER
W. S. Vaughn, Jr. and Jerome Williams (Naval Academy) Apr. 1976 59 p refs
(Contract N00014-74-C-0276; NR Proj. 196-134)
(AD-A026035) Avail: NTIS HC A04/MF A01 CSCL 05/8

Mixed gas underwater breathing apparatus and ambient submersibles extend the range of activities that can be accomplished by a diver. Correspondingly, the divers' needs for information transfer via visual displays are increased. Diver displays have not been designed to account for the unusual physical and perceptual effects of undersea viewing. The present project provides a systematic foundation of requirements for the optimization of visual display design for undersea applications. One of the principal classes of visual tasks required of divers is quantitative reading, and a variety of display types support this task: digital counters, round dials, horizontal and vertical tapes, and light emitting diode displays. Display characteristics related to legibility include viewing distance, symbol size, luminance, color and location in the visual field. Optimum values of these characteristics depend on the turbidity and luminance characteristics of the viewing environment, and on the visual-perceptual characteristics of the underwater viewer. Detailed analyses were made of these two sources of determinants of display legibility for a range of conditions typical of undersea operations. Results of the analyses provide general guides for display optimization in undersea viewing environments, and a foundation for experiments needed to more precisely specify display parameter-legibility relationships. GRA

N77-15656# Naval Training Equipment Center, Orlando, Fla. Human Factors Lab.
REQUIREMENTS FOR COLOR IN TELEVISION DISPLAYS Final Report, Sep. 1975 - Jun. 1976
Joseph A. Puig Jun. 1976 25 p refs
(AD-A026747; NAVTRAEQUIPC-TN-50) Avail: NTIS HC A02/MF A01 CSCL 05/5

A review of the literature was made as part of Task 6723-01, Wide-Angle High Resolution Color TV Technique for Training Systems. Forty-one references were consulted, twelve of which described research in applied experimental settings. Subjects in ten of the twelve studies showed some improvement in performance as a result of using color in the displays. The decision as to whether a color or monochrome television system should be used appears to be dependent on the specific application and cost factors. If either type could be produced and maintained for equivalent costs, then there is evidence to suggest that performance with color TV would be as good, and for some applications, better than monochrome TV. GRA

N77-15657# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
A STATE SPACE MODEL FOR SENSORIMOTOR CONTROL AND LEARNING
Marc Raibert Jan. 1976 37 p refs
(Contract N00014-75-C-0643)
(AD-A026960; AI-M-351) Avail: NTIS HC A03/MF A01 CSCL 05/10

The report is the first of a two-part presentation which deals with certain computer controlled manipulator problems. This first part discusses a model which is designed to address problems of motor control, motor learning, adaptation, and sensorimotor integration. The problems are outlined and a solution is given which makes use of a state space memory and a piece-wise linearization of the equations of motion. A forthcoming companion article will present the results of tests performed on an implementation of the model. GRA

N77-15658# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
SPATIAL KNOWLEDGE
Benjamin Kuipers 1 Jun. 1976 52 p refs
(Contract N00014-75-C-0643)
(AD-A026874; AI-M-359) Avail: NTIS HC A04/MF A01 CSCL 05/10

This paper introduces a model of spatial cognition to describe the states of partial knowledge that people have about the spatial structure of large-scale environment. Spatial knowledge has several different representations, each of which captures one aspect of the geography. With knowledge stored in multiple representations, we must examine the procedures for assimilating new information, for solving problems, and for communicating information between representation. Author (GRA)

N77-15659# DARCOM Intern Training Center, Texarkana, Tex.
THE FEASIBILITY OF SHORT INTERVAL TIME ESTIMATION AS A METHODOLOGY TO FORECAST HUMAN PERFORMANCE OF A SPECIFIED TASK Final Report
John E. Phillips Apr. 1976 86 p refs Prepared in cooperation with Texas A and M Univ., Texarkana
(AD-A026757; DARCOM-ITC-02-08-76-010) Avail: NTIS HC A05/MF A01 CSCL 05/10

This paper proposes and initiates the testing of the hypothesis which states: 'An estimate of a short interval of time will indicate one's ability to perform a specified task relative to his ability to perform this same task at other points in time throughout the day'. The investigation includes a survey of previous time estimation research and other related chronobiologic studies. It examines the interval estimation - task performance relationship by correlating two short intervals of time with performance of a letter cancellation task. GRA

N77-15660# DARCOM Intern Training Center, Texarkana, Tex.
AN INITIAL INVESTIGATION OF THE EFFECT OF REPEATED HIGH INTENSITY FLASHES ON MAN'S PERFORMANCE OF A TRACKING TASK Final Report
Martin E. Winkler Mar. 1976 90 p refs Prepared in cooperation with Texas A and M Univ., Texarkana
(AD-A026824; DARCOM-ITC-02-08-76-115) Avail: NTIS A05/MF A01 CSCL 05/5

The paper is a report of research designed to investigate the effect of repeated glare on human performance of a tracking

task. The experiment used an EAI 680 computer to create the tracking task as well as to record the experimental data. Subjects were dark-adapted for thirty minutes and then performed the tracking task for a half hour fun period. During the run the subject experienced four flashes from a glare source. A control run, with no dark-adaption or intermittent flashes, was performed by all five subjects. Performance was measured by the time required to reach a predetermined level of error, while a biological factor was measured by the lowest galvanic skin resistance value during the time period prior to reaching the error level. Statistical analysis showed both the flash-time factor and the condition flash-time interaction to be significant at the 95% level of confidence. Graphical analysis showed the subjects' performance to increase with time while operating the tracking task under the glare condition. GRA

N77-15661# DARCOM Intern Training Center, Texarkana, Tex.
GLARE RECOVERY OF A TWO DIMENSIONAL TRACKING TASK WITH RESPECT TO VARIOUS COLORS Final Report
Dennis A. Boyer Apr. 1976 73 p refs
(AD-A026759; DARCOM-ITC-02-08-76-015) Avail: NTIS HC A04/MF A01 CSCL 05/5

The results of research intended to determine the effect of variation in color on a two dimensional tracking task with superimposed glare flashes are described. The EAI 680 Analog Computer was the primary function generator with the EAI 600 Pacer digital computer performing control functions and Data analysis. Tests on five subjects under four colors indicates that the blue filtered light was significantly better than white, red, or orange-red filtered light when a glare was imposed. GRA

N77-15662# California Univ., Los Angeles. Dept. of Computer Science.
BIOCYBERNETIC CONTROL IN MAN-MACHINE INTERACTION Semiannual Technical Report, 1 Jul. 1975 - 31 Jan. 1976
Jacques J. Vidal, M. D. Buck, R. J. Hickman, and R. H. Olch Mar. 1976 99 p refs Sponsored in cooperation with San Diego State Found., Calif.
(Contract N00014-76-C-0185; ARPA Order 3065)
(AD-A026193; UCLA-ENG-7657) Avail: NTIS HC A05/MF A01 CSCL 06/4

A progress report is presented of a project directed toward the evaluation and implementation of man-machine command and control procedures that incorporate neuroelectric signals directly derived from the brain. This document first reports on the current state of the project. A first milestone has been reached: one such man-machine loop has been operating for several months at nearly operational performance levels. In the communication protocol of this 'MASTER-ROBOT' team, the computer robot executes commands encoded in the master's occipital brain waves (as SINGLE OPOCH VISUAL EVOKED RESPONSES). To send a command the master visually selects the corresponding command symbol from a displayed set. Symbol pattern and color have been used in the command alphabet. GRA

N77-15663# California Univ., Los Angeles. Dept. of Computer Science.
BIOCYBERNETIC CONTROL IN MAN-MACHINE INTERACTION Final Technical Report, 1 Jul. 1974 - 30 Jun. 1975
Jacques J. Vidal, M. D. Puck, R. J. Hickman, and R. H. Olch Sep. 1975 82 p
(Contract N00014-69-A-0200-4055; ARPA Order 2816)
(AD-A026194; UCLA-ENG-7654) Avail: NTIS HC A05/MF A01 CSCL 06/4

The research is a continuation of a program aimed at incorporating EEG 'evoked responses' in man-machine communication. A methodology for the single-epoch discrimination of evoked responses has been developed. The approach is compatible with real-time computing. High rates of stimulus identification have been obtained with several types of visual stimuli. GRA

N77-15664# Army Materiel Command, Texarkana, Tex. Intern Training Center.
THE EFFECTS OF DRIVER COMFORT ON VEHICLE SPEED Final Report
Charles H. Berry, Jr. Dec. 1975 39 p refs
(AD-A026348; USAMC-ITC-02-08-76-406) Avail: NTIS HC A03/MF A01 CSCL 05/9

This report describes the results of research intended to determined the correlation between vehicular design and speed driven without the aid of the speedometer. The results from experiments with 21 male subjects indicate a significant difference in the comfortable speeds of 3 test vehicles. The results show that the comfortable speed for drivers is well above the present speed limit of 55 mph. Implied by these results is the need for further research in vehicle design characteristics to coincide the comfortable speed with the speed limits. Author (GRA)

55 PLANETARY BIOLOGY

Includes exobiology and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.
For components see *33 Electronics and Electrical Engineering*.

N77-15665 Rensselaer Polytechnic Inst., Troy, N.Y.
THEORY AND DESIGN OF AN ON-LINE MINICOMPUTER BASED IMAGE PROCESSING SYSTEM Ph.D. Thesis
Edward M. Sims 1976 348 p
Avail: Univ. Microfilms Order No. 76-27210

The integrated conceptual development and hardware/software design of the Rensselaer On-Line Image Processing System (ROLIPS) are documented. The goal is twofold: the exposition of a theory of system design together with a detailed description of its actual implementation in hardware and in software. Major innovations of this design include the incorporation of a special purpose scan processor for the formatting of data by oriented line segments and other structural elements, the design and implementation of alternate image data management schemes (file-oriented and record-sequential), and the augmentation, through hardware, of the CPU instruction set to include image I/O macro-operations. The design parameters for each of these innovations are developed from theoretical considerations of intrinsic image properties. Dissert. Abstr.

N77-15666 Texas Univ., Austin.
DEVELOPMENT OF METHODOLOGIES AND TOOLS FOR THE DESIGN OF A RELIABLE MINICOMPUTER SYSTEM Ph.D. Thesis
Vernell Trent Montgomery 1976 183 p
Avail: Univ. Microfilms Order No. 76-26677

A study of physical defects which cause electronic semiconductor devices to fail is presented. Statistics on the causes of failures are also presented. The effects of common intermodule faults on transistor-transistor logic, emmitercoupled logic, and complementary metal oxide semiconductor logic was studied.

Better fault modeling techniques for digital fault simulators are suggested. A new type of semiconductor integrated circuit which detects faults between logic modules and is also self-checking was developed. The hybrid semiconductor gate uses an internal duplicate-and-match circuit to accomplish this feat. The internal function of the gate was duplicated in different logic-families. The amount of internal hardware, in some gates, was reduced by using threshold logic for the secondary function.
Dissert. Abstr.

N77-15667 California Univ., Irvine.
A FORMALIZATION FOR MODELLING STRUCTURES AND THE GENERATION OF EFFICIENT IMPLEMENTATION STRUCTURES Ph.D. Thesis
Lawrence Arnold Rowe 1976 287 p
Avail: Univ. Microfilms Order No. 76-29272

Formalisms for modelling structures and for implementation structures are developed which extend the domain of modelling structures that can be accepted and the range of implementations that can be generated by implementation synthesis systems. A paradigm for generating alternative implementations is investigated which retrieves predefined implementations for those known modelling structures which can be mechanically recognized and synthesizes implementations for those structures not recognized. The problem of deriving mechanically the information necessary to generate efficient implementations for several interacting structures, is discussed. Implementation coalescing is defined and an implementation selection algorithm which handles coalescings is developed, based on branch and bound search techniques. Dissert. Abstr.

N77-15668# Materials Research Labs., Maribyrnong (Australia).
A DATA ACQUISITION SYSTEM FOR CLOSED VESSEL TESTING OF GUN PROPELLANTS. PART 2: SYSTEM DESIGN
C. I. Sach Jul. 1976 63 p refs
(MRL-R-664-Pt-2; AR-270-Pt-2) Avail: NTIS HC A04/MF A01

A data acquisition system is described which takes as its input the electric current developed by a piezoelectric pressure transducer mounted in the closed vessel. The current is proportional to rate of change of gas pressure. The output is available in the form of samples of the input signal produced on punched paper tape or, alternatively, as an X-Y display of the variation of rate of change of pressure against pressure.
Author

N77-15669*# Teledyne Brown Engineering, Huntsville, Ala. Advanced Projects Div.
INVESTIGATION OF SELECTED DISK SYSTEMS
Oct. 1976 32 p
(Contract NAS8-31488)
(NASA-CR-150165; APF76-MSFC-02222) Avail: NTIS HC A03/MF A01 CSCL 09B

The large disk systems offered by IBM, UNIVAC, Digital Equipment Corporation, and Data General were examined. In particular, these disk systems were analyzed in terms of how well available operating systems take advantage of the respective disk controller's transfer rates, and to what degree all available data for optimizing disk usage is effectively employed. In the course of this analysis, generic functions and components of disk systems were defined and the capabilities of the surveyed disk system were investigated. Author

N77-15670*# Teledyne Brown Engineering, Huntsville, Ala. Advanced Projects Div.
INTERFACE STANDARDS FOR COMPUTER EQUIPMENT
Sep. 1976 50 p refs
(Contract NAS8-31488)
(NASA-CR-150166; APF76-MSFC-02173) Avail: NTIS HC A03/MF A01 CSCL 09B

The ability to configure data systems using modules provided by independent manufacturers is complicated by the wide range of electrical, mechanical, and functional characteristics exhibited within the equipment provided by different manufacturers of computers, peripherals, and terminal devices. A number of international organizations were and still are involved in the creation of standards that enable devices to be interconnected with minimal difficulty, usually involving only a cable or data bus connection that is defined by the standard. The elements covered by an interface standard are covered and the most prominent interface standards presently in use are identified and described. Author

N77-15671*# Teledyne Brown Engineering, Huntsville, Ala. Advanced Projects Div.
DATA BASE MANAGEMENT STUDY Interim Report
May 1976 62 p
(Contract NAS8-31488)
(NASA-CR-150167; APF76-MSFC-02127) Avail: NTIS HC A04/MF A01 CSCL 09B

Data base management techniques and applicable equipment are described. Recommendations which will assist potential NASA data users in selecting and using appropriate data base management tools and techniques are presented. Classes of currently available data processing equipment ranging from basic terminals to large minicomputer systems were surveyed as they apply to the needs of potential SEASAT data users. Cost and capabilities projections for this equipment through 1985 were presented. A test of a typical data base management system was described, as well as the results of this test and recommendations to assist potential users in determining when such a system is appropriate for their needs. The representative system tested was UNIVAC's DMS 1100. Author

N77-15672# Sandia Labs., Albuquerque, N.Mex.
MINICOMPUTER FRONT END
Jack A. Hudson 1976 11 p Presented at AESOP;SCIE meeting, Washington D. C., 1 Apr. 1976 Sponsored by ERDA
(SAND-76-5354; Conf-760440-1) Avail: NTIS HC A02/MF A01

Sandia Labs developed an interactive graphics system (SIGS) that was established on a CDC 6600 using a communication scheme based on the product IGS. The graphics station consists primarily of a PDP-9 with a vector general display. A system is being developed which uses a minicomputer (Modcomp II/CP) as the buffer machine for the graphics stations. With the Modcomp handling the actual communication protocol, the peripheral precessor PP is only assigned as needed to handle data transfer within the CDC 6600 portion of SIGS. The new system will thus support additional graphics stations with less impact on the CDC 6600. The design philosophy of the system, and the hardware and software used to implement it is disscussed. ERA

N77-15673# Oak Ridge National Lab., Tenn.
RAISE YOUR HAND IF YOU KNOW WHAT CAMAC IS
Carl A. Ludemann 1976 16 p refs Presented at Natl. Computer Conf., New York 7, Jun. 1976 Sponsored by ERDA
(CONF-760604-3) Avail: NTIS HC A02/MF A01

A brief history and description of the nonproprietary standard interface system, CAMAC, is presented to familiarize computer-oriented readers with CAMAC. Commercially available CAMAC components are overviewed. The benefits to be realized by computer users and manufacturers if CAMAC is premitted to realize its potential are discussed. ERA

N77-15674# California Univ., Livermore. Lawrence Livermore Lab.
MINERVA MULTI-MICROPROCESSOR
L. C. Widdoes, Jr. 1 Dec. 1975 30 p refs Presented at the 3d Ann. Symp. on Computer Architecture; Clearwater, Fla., 19 Jan. 1976
(Contract W-7405-eng-48)
(UCRL-77828; Conf-760113-1) Avail: NTIS HC A03/MF A01

A multiprocessor system is described which is an experiment in low cost extensible, multiprocessor architectures. Global issues such as inclusion of a central bus, design of the bus arbiter, and methods of interrupt handling are considered. The system initially includes two processor types, based on microprocessors, and these are discussed. Methods for reducing processor demand for the central bus are described. ERA

N77-15675# California Univ., Livermore. Lawrence Livermore Lab.
FILEM: A FILE MANAGEMENT SYSTEM

J. H. Choy Dec. 1975 14 p refs Presented at Natl. Computer Conf., New York, 7 Jun. 1976
(Contract W-7405-eng-48)
(UCRL-77622; Conf-760604-1) Avail: NTIS HC A02/MF A01

The design of a multi-level store file management system is described. The index structure and functional capabilities of the system are presented. The roles of disk and tape in the system, how the system was debugged, periodic checks of the disk space management, some interesting statistics, and the future of the FILEM system were examined. ERA

N77-15676# California Univ., Livermore. Lawrence Livermore Lab.
GENERATION OF FIRMWARE FOR CONTROL MICROPROCESSORS
M. N. Matelan 11 Dec. 1975 9 p refs Presented at 13th Design Automation Conf., Palo Alto, Calif., 27 Jun. 1976
(Contract W-7405-eng-48)
(UCRL-77580; Conf-760609-5) Avail: NTIS HC A02/MF A01

The development of a system intended to generate firmware (programs) for microprocessors is outlined. Instead of requiring that a designer produce detailed programs, this system will allow one to describe the interface between a microprocessor and its environment. Stimulus-response interactions are described in a non-procedural, easy-to-learn notation which can relieve the designer of burdens related to control flow analysis and sequencing management. Behavioral specifications prepared by using the system would share a common format and notation and thus contribute to better communications related to the design. ERA

N77-15677# Harry Diamond Labs., Adelphi, Md.
FORTRAN IV COMPILER-LOADER FOR THE WANG 520/600 CALCULATOR
Howard M. Bloom, Arthur Hausner, and Robert J. Kushlis Mar. 1976 69 p refs
(HDL Proj. Y98CY3; HDL Proj. 398C39)
(AD-A026130; HDL-TM-73-15S) Avail: NTIS HC A04/MF A01 CSCL 09/2

This paper describes a compiler system that will translate FORTRAN IV programs into programs that will run on the Wang 520/600 programmable calculator. The system includes an option to generate the Wang programs on punched cards that can be input into the 520 or 600 via a mark-sense card reader. The compiler was written in FORTRAN IV for the IBM 370/195 computer. Only a few minor changes are necessary to run the system on a different computer. This paper includes a detailed description on the types of optimization used to yield an effective FORTRAN translation onto a relatively small computer (i.e., desk calculator). GRA

N77-15678# Defense Systems Management School, Fort Belvoir, Va.
COMPUTER SYSTEM SIMULATION: A DESIGN EVALUATION TOOL
Robert Steven Feingold May 1976 108 p refs
(AD-A026387) Avail: NTIS HC A06/MF A01 CSCL 09/2

Computers embedded within weapon systems add to their complexity and to the difficulty encountered in developing such weapon systems within cost and schedule constraints with required performance. A primary contributor to the difficulty in achieving success with an embedded computer system development is the heretofor lack of a procedural approach to computer system design evaluation and lack of tools suitable to provide understandable and responsive analyses. Two propositions are presented. First, that computer system design evaluation activities should follow a six step process consisting of: requirements analysis, design alternative synthesis, model building, experimentation, evaluation of results and documentation. Conduct of this procedure should be done by an integrated design evaluation team of users, designers, and developers. Early use of the procedure introduces discipline to the process which might otherwise be driven by emotional bias. The team approach minimizes communication gap problems and shortens the overall design process. The second proposition states that computer system simulation is a valuable tool which can be effectively used during the validation phase to articulate designs in the form of readable models and to gather valuable estimates of performance for each proposed design. GRA

N77-15679# Air Force Human Resources Lab., Brooks AFB, Tex.
DEVELOPMENT OF A PLASMA PANEL HARD COPY UNIT Final Report, Feb. - Nov. 1975
Edward M. Gardner and Lyle R. McKnight Dec. 1975 22 p (AF Proj. 1121)
(AD-A026120; AFHRL-TR-75-81) Avail: NTIS HC A02/MF A01 CSCL 09/2

This report describes an investigation of a technique for producing paper copies of instructional computer terminal displays. Such a device appears to be a useful adjunct for the development of computer assisted instructional programs by authors. A digital device was simulated with a minicomputer; the techniques used to construct this device are described in this technical report. Examples of the hard copy produced and a description of the computer program used in the simulation are included in the report. Author (GRA)

N77-15680# DARCOM Intern Training Center, Texarkana, Tex.
A HASP MULTI-LEAVING TERMINAL SIMULATOR FOR THE EAI PACER-100 DIGITAL PROCESSOR Final Report
Edwin K. Thomas Apr. 1976 127 p refs
(AD-A026758; DARCOM-ITC-02-08-76-109) Avail: NTIS HC A07/MF A01 CSCL 09/2

It is advantageous for engineers and managers to have access to large digital computing systems. However, in most cases the cost of maintaining such a system would be totally prohibitive. A more economic solution to this problem would be the use of a small general purpose minicomputer operating as a HASP multi-leaving remote batch terminal. Such a system would not only provide remote access to the large computing system when necessary, but may also be used to run small off-line jobs at a much lower cost. This paper describes the design of a HASP communications package enabling an EAI PACER-100 minicomputer to communicate with large HASP-supported processing systems. GRA

N77-15681# Dayton Univ. Research Inst., Ohio.
THREE DIMENSIONAL DISPLAY OF THE COMBIMAN MAN-MODEL AND WORK SPACE Final Report
Frank J. Bates, Jr., Susan M. Evans, Horst E. Krause, and Henry Luming Jul. 1976 56 p refs
(Contract F33615-71-C-1113; AF Proj. 7184)
(AD-A027175; UDRI-TR-73-47; AMRL-TR-74-15) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report describes the status of the COMputerized Biomechanical MAN-model, COMBIMAN, as of Oct 73. It deals with the theoretical development of the concepts of the COMBIMAN model, and their application. COMBIMAN is a 3-D computer graphic manikin used for the design and evaluation of workplaces. The report explains the modelling technique used in constructing the man-model. Equations were derived which allow the user to compute the coordinates of points on the model in a specified body position. These equations form the core of the COMBIMAN computer programs. The report also describes the theoretical background and techniques for the prediction of human attitudes in specified task/or environmental conditions. Using the described techniques for constructing and positioning the model, the report also deals with predicting the reach capabilities of a human operator. GRA

N77-15682# Southern Methodist Univ., Dallas, Tex. Dept. of Industrial Engineering and Operations Research.
AN EVALUATION OF CPU EFFICIENCY UNDER DYNAMIC QUANTUM ALLOCATION
U. Narayan Bhat and Richard E. Nance Oct. 1975 27 p refs Prepared in cooperation with Virginia Polytechnic Inst. and State Univ.
(Contract N00014-75-C-0517; NR Proj. 042-324)
(AD-A027200; IEOR-75012) Avail: NTIS HC A02/MF A01 CSCL 09/2

A model for a time-sharing operating system is developed in order to assess the effects of dynamic quantum allocation and overhead variability on central processing unit (CPU) efficiency.

CPU efficiency is determined by the proportion of time devoted to user-oriented (problem state) tasks within a busy period. Computational results indicate that a dynamic quantum allocation strategy produces significant differences in CPU efficiency compared to a constant quantum. Strategies that increase the quantum with increasing load effect lower CPU efficiency; while strategies using decreasing quantum produce mixed results. Overhead variability also causes a pronounced effect. A conjecture is stated that relates the average quantum length to the effect on CPU efficiency under a fixed strategy 'variability'. GRA

N77-15683# Naval Postgraduate School, Monterey, Calif.
DESIGN MANUAL FOR THE VECTOR GENERAL GRAPHICS DISPLAY UNIT
Lloyd A. Thorpe and Gary M. Raetz 15 Mar. 1976 81 p refs
(AD-A027254; NPS-72RR76032) Avail: NTIS HC A05/MF A01 CSCL 09/2

This report describes the program description of an interactive graphics package interfacing the Vector General Graphics Display Unit and a Digital Equipment Corporation PDP-11/50 computer. The program was written in the C-programming language and designed to be used in the multiprogramming environment of the UNIX Timesharing operating system. Included is a description of the Vector General, operating system modifications, device driver, and interface routines. Author (GRA)

N77-15684# Naval Postgraduate School, Monterey, Calif.
USERS MANUAL FOR THE VECTOR GENERAL GRAPHICS DISPLAY UNIT
Lloyd A. Thorpe and Gary M. Raetz 15 Mar. 1976 89 p refs
(AD-A027353; NPS-72RR76031) Avail: NTIS MF A01 CSCL 09/2

This report is the description of a users manual for an interactive graphics package designed to allow programmatic control of the Vector General Graphics Display Unit from a Digital Equipment Corporation PDP-11/50 computer. The manual requires a knowledge of the C-programming language and a general familiarity with graphics terminology. Included is a brief description of the Vector General Graphics Display Unit, a description of the interface routines, and a description of the Vector General graphics display instructions. Author (GRA)

N77-15685# University of Southern Calif., Marina del Rey. Information Sciences Inst.
PROTECTION ERRORS IN OPERATING SYSTEMS: ALLOCATION/DEALLOCATION RESIDUALS
Dennis Hollingworth and Richard Bisbey, II Jun. 1976 19 p ref
(Contract DAHC15-72-C-0308; ARPA Order 2223)
(AD-A026441; ISI/SR-76-7) Avail: NTIS HC A02/MF A01 CSCL 09/2

A common security problem is the residual--data or access capability left after the completion of a process and not intended for use outside the context of that process. If the residual becomes accessible to another process, a security error may result. A major source of such residuals is improper or incomplete allocation/deallocation processing. The various types of allocation/deallocation residuals are discussed in terms of their characteristics and the manner in which they occur, and a semiautomatable search strategy for detecting sources of these residuals is presented. Author (GRA)

N77-15686# University of Southern Calif., Marina del Rey. Information Sciences Inst.
PROTECTION ERRORS IN OPERATING SYSTEMS: VALIDATION OF CRITICAL CONDITIONS
Jim Carlstedt May 1976 35 p refs
(Contract DAHC15-72-C-0308; ARPA Order 2223)
(AD-A026442; ISI/SR-76-5) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report describes a class of operating system protection errors known as 'insufficient validation of critical conditions,' or simply 'validation errors,' and outlines a scheme for finding them. This class of errors is recognized as a very broad one, lying outside the scope of the basic protection mechanisms of existing systems; the extent of the problem is illustrated by a set of validation errors taken from current systems. Considerations for validity conditions and their attachment to variables and to various types of control points in procedures are explored, and categories of validation methods noted. The notion of criticality itself is analyzed, and criteria suggested for determining which variables and control points are most critical in the protection sense. Because a search for validation errors can involve substantial information processing, the report references existing or developing tools and techniques applicable to this task. Author (GRA)

N77-15687# University of South Florida, Tampa. Dept. of Electrical and Electronic Systems.
A SURVEY OF COMPUTER-AIDED-DESIGN AND ANALYSIS PROGRAMS Final Report, Jan. 1975 - Jan. 1976
James C. Bowers, Charles Lors, John E. OReilly, George Wzobrist, and Thomas Rodby Apr. 1976 234 p refs
(Contract F30602-75-C-0113; AF Proj. 3145)
(AD-A026567; AFAPL-TR-76-33) Avail: NTIS HC A11/MF A01 CSCL 09/2

This report contains a survey of sixteen computer aided design programs useful for electronic circuit analysis. Most of the well known, first generation programs (such as ECAP) were not included in this survey. These older programs can no longer compete with the second and third generation nonlinear, sophisticated programs. However, some of the lesser known European linear programs were included, as a matter of information only. It is divided into three major parts. Part 1 contains general data on each program along with a summary of each of the user's manuals. This part of the report is prefixed by four tables which summarize the properties of all the programs. Part 2 of the report contains a critical analysis of each of the programs. The eighteen circuits given in the appendix were the basis upon which flexibility, accuracy, and cost comparisons were made. Part 3 contains a comparison analysis of all the programs and conclusions which may be known from the results of this survey. As a result of some of the advanced publicity concerning this survey, several individuals brought to our attention programs which were not being included. Some of these do look promising, but were unknown and unpublished, hence there was no realistic way to have found out about them in time. Author (GRA)

N77-15688# Michigan Univ., Ann Arbor. Systems Engineering Lab.
PRELIMINARY REPORT ON RESULTS OF MATRIX BENCHMARKS ON VECTOR PROCESSORS Interim Report
D. A. Calahan, W. N. Joy, and D. A. Orbits 24 May 1976 72 p refs
(Grant AF-AFOSR-2812-75; AF Proj. 9749)
(AD-A027710; SEL-TR-94; AFOSR-76-0927TR) Avail: NTIS HC A04/MF A01 CSCL 09/2

This preliminary report presents the results of running full matrix benchmarks on the CDC STAR 100, the Cray Research Cray-1, the Texas Instruments ASC (1-pipe and 4-pipe), the IBM 370/195, and the Amdahl 470V/6. An analysis is performed on timing results to correlate measured results with those predicted from manufacturer-supplied data. This benchmark effort is part of a study to measure the effectiveness of vector processors for (direct) solution of large sparse sets of simultaneous equations, and to develop new algorithms appropriate to classes of computer architecture. GRA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

N77-15689 Pittsburgh Univ., Pa.
MULTIVARIABLE POLYNOMIAL POSITIVITY ALGORITHMS USING INNERS WITH APPLICATIONS Ph.D. Thesis
Abdol-Reza Modarressi 1976 138 p
Avail: Univ. Microfilms Order No. 76-21779

Algorithms were developed, using notions of decision algebra and decidability theory, to test for global and nonglobal positivity (negativity) of multivariable polynomials, which has applications in several important system theory problems. After the problem

was formulated in decision-theoretical terms, an approach is adopted for its solution using a variant of Sturm's theorem in terms of inner matrices and their determinants. Various singular or critical cases that arise in the implementation of the algorithms were considered in detail, and methods for resolving them are pointed out. The computational aspects of the algorithms, and the programming devices used for their implementation on a digital computer, are also discussed. Dissert. Abstr.

N77-15690 California Univ., Irvine.
A PARAMETRIC DISK SCHEDULING POLICY Ph.D. Thesis
Ram Prasad Singhania 1976 166 p
Avail: Univ. Microfilms Order No. 76-29273

A parametric scheduling policy (RSCAN), is proposed which can be used to achieve the effect of a wide variety of different scheduling strategies. The parameter of the RSCAN policy, R, is a combination of two inter-dependent fractions: fraction of old requests and fraction of new requests that receive service in a given cycle, combined in such a way that no new request is serviced until service to all the old requests in the cycle is guaranteed. An algorithm for the RSCAN policy is developed which showed that a meaningful tradeoff exists between different measures of performance for different values of R. Thus, the RSCAN policy is used to achieve an optimal response set for a given job mix according to an overall utility function reflecting the relative importance of the members of the performance set. Dissert. Abstr.

N77-15691 Maryland Univ., College Park.
ITERATIVE ENHANCEMENT: A PRACTICAL TECHNIQUE FOR SOFTWARE DEVELOPMENT Ph.D. Thesis
Albert Joseph Turner, Jr. 1976 114 p
Avail: Univ. Microfilms Order No. 76-29020

A software development methodology is proposed as a technique that can facilitate the use of a top-down approach to software implementation and the achievement of a modifiable, reliable and efficient software product at a reasonable cost. Included are a description, application and analysis of the technique. Iterative enhancement is a heuristic procedure that begins with an initial implementation of a skeletal subproblem or nucleus of the desired implementation. Existing implementations are iteratively enhanced by adding new facilities and correcting design and coding flaws until the final desired implementation is obtained. An important part of the process is the careful analysis of each intermediate implementation in order to discover flaws in the design or coding. Dissert. Abstr.

N77-15692 Michigan Univ., Ann Arbor.
TRANSFORMATION OF LOOP PROGRAMS FOR PARALLEL EXECUTION Ph.D. Thesis
Daniel Shih-chia Lo 1976 226 p
Avail: Univ. Microfilms Order No. 76-27530

The methods of transforming loop programs discussed here include decomposition, methods of temporary saving, substitution, partial decomposition and hyperplate method which is a generalization of hyperplane method. A systematic procedure for applying the various methods is suggested which, in a majority of cases, may enable automatic transformation of loop programs. Dissert. Abstr.

N77-15693 Pennsylvania State Univ., University Park.
WORST CASE ANALYSIS OF MULTIPROCESSOR SCHEDULING ALGORITHMS Ph.D. Thesis
Shui-Fung Lam 1975 127 p
Avail: Univ. Microfilms Order No. 76-26831

Given a set of tasks to be executed on a multiprocessor system, the time taken to finish all the tasks (the schedule length) provides a measure of processor utilization. Scheduling algorithms that tend to minimize schedule lengths were considered. Most such algorithms execute tasks level by level. Coffman and Graham give a level algorithm to schedule unit execution time task systems nonpreemptively. On two identical processors, their algorithm was optimal. On m greater than or equal to 2 identical processors, the ratio of the lengths of a Coffman-Graham and an optimal schedule was bounded by 2 to 2/m. Moreover, the bound 2 to 2/m was best possible in that for all values of m there exist task systems for which the ratio can be achieved arbitrarily closely. No level algorithm can yield a smaller bound than 2 to 2/m. Dissert. Abstr.

N77-15694# BDM Corp., Vienna, Va.
CENTRAL FLOW CONTROL SOFTWARE SYSTEMS ANALYSIS. VOLUME 1: EXECUTIVE SOFTWARE STUDY Final Report
George G. Kershaw Jul. 1976 33 p
(Contract DOT-FA76WA-3792)
(AD-A030399/0; FAA-RD-76WA-3792-1-Vol-1; FAA-RD-76-160-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 09/2

An analysis of the 9020 Monitor was conducted to identify added functional capabilities necessary to support central flow control data base requirements. Management of the memory, processors, and peripheral storage devices is described. Multiprocessing and multiprogramming techniques are discussed. Author

N77-15695# BDM Corp., Vienna, Va.
CENTRAL FLOW CONTROL SOFTWARE SYSTEMS ANALYSIS. VOLUME 2: DATA BASE SOFTWARE STUDY Final Report
George G. Kershaw and Travis D. Guye Jul. 1976 92 p
(Contract DOT-FA76WA-3792)
(AD-A030352/9; FAA-RA-76WA-3792-Vol-2; FAA-RD-76-160-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 09/2

The operational requirements of central flow control were analyzed to determine the database structure and database software requirements. This data base administration, data base organization and access, and data independence are discussed. Author

N77-15696# California Univ., Livermore. Lawrence Livermore Lab.
SOFTWARE TOOLS IN AN AUDIT ENVIRONMENT
D. A. Webb 1976 6 p refs Presented at the NSF Software Auditing Workshop, San Francisco, 29 Jan. 1976
(Contract W-7405-eng-48)
(UCRL-78095; Conf-760116-1) Avail: NTIS HC A02/MF A01

Security analysis of operating systems is reported. Background information, including motivation and goals, is given first. Analytic and other types of tools are then described, and security analysis in an audit environment is discussed. A set of possible future tools is listed, and some open questions regarding auditing with software tools are set forth. ERA

N77-15697# Air Force Weapons Lab., Kirtland AFB, N.Mex. Pointing and Tracking Branch.
A DIGITIZING SYSTEM FOR 525 LINE, 60 Hz, MONOCHROME TELEVISION Final Report
Donald C. Anderson Jun. 1976 65 p refs
(AF Proj. 317J)
(AD-A027298; AFWL-TR-76-3) Avail: NTIS HC A04/MF A01 CSCL 09/5

A description is given of a video processing system which is capable of digitizing 525 line, 60 Hz, 2:1 interlace, monochrome television. The system digitizes an area of the TV frame which is programmable in size and position from a programmable number of frames. This is achieved by first recording the data interval to be digitized onto an analog video disc recorder and then digitizing from the disc in a piecemeal manner. A 10 MHz sampling reference is used, allowing a maximum of 524 samples per horizontal TV line with each sample being resolved to a 6-bit binary word. Digital values are assigned according to picture brightness at a given sampling point in the raster with reference black being 0 and reference white being 63. Digital output is recorded on seven-track magnetic tape. Normal input to the system is from a video tape recorder, although the system will accept 525 line standard video from any source. For video tape recorder data, time base correction is provided. IRIG time is included with the digital output using the vertical interval encoding technique. The system offers the advantages of good versatility and high processing speed, although positional repeatability is limited to + or - 1/2 cycle of the reference oscillator. Author (GRA)

N77-15698# Massachusetts Inst. of Tech., Cambridge. Operations Research Center.
COMPUTER PROGRAMS FOR THE MATHEMATICAL PROGRAMMING MODELS IN PRODUCTION PLANNING
Silvia Pariente and Arnoldo C. Hax May 1976 62 p refs
(Contracts N00014-75-C-0556; N00014-75-C-0661; NR Proj. 347-027; MIT Proj. OSP-82491)
(AD-A026344; TR-124) Avail: NTIS MF A01 CSCL 09/2

Production is concerned with the determination of production inventory and work force levels to meet fluctuating demand requirements. Mathematical programming is suited particularly well for supporting these types of decisions. The first purpose of this paper is to review the different types of mathematical programming models that can be used to support production planning decisions. The second objective is to describe a set of computer programs that allow the input of model data and the solution of the mathematical programming model. Some computational results are also given. Author (GRA)

N77-15699# Analytics, Inc., Willow Grove, Pa.
STRUCTURAL MODIFICATION OF THE THREE-DIMENSIONAL CRASH VICTIM SIMULATION (3DCVS) SOFTWARE
20 May 1976 15 p
(AD-A027726; TR-1194-A) Avail: NTIS HC A02/MF A01 CSCL 09/2

The 3DCVS software was to be modified to accomplish the following objectives: (1) Reduce core requirement for simulation execution; (2) Reduce simulation execution costs; (3) Improve job turnaround time; and (4) Make core available for further extention of the 3DCVS. GRA

N77-15700# Defense Systems Management School, Fort Belvoir, Va.
RELIABLE COMPUTER SOFTWARE. WHAT IT IS AND HOW TO GET IT
David N. Farnan Nov. 1975 42 p refs
(DSMS Proj. PMC-75-2)
(AD-A026988) Avail: NTIS HC A03/MF A01 CSCL 09/2

The paper attempts to motivate software acquisition managers to give more attention to software development. Up to now, more attention has been given to hardware acquisition at the expense of software. Since computer software can't really be seen, it is easily ignored. Therefore, it requires greater management visibility. There are many techniques available today which can improve the software design and increase software reliability. The techniques briefly described are: modularization, top-down programming, structured programming, egoless programming, chief programmer team, good programming style, and configuration management. Author (GRA)

N77-15701# Naval Research Lab., Washington, D.C. Acoustics Div.
COMPUTER PROGRAMS FOR OBTAINING SOUNDSPEEDS FROM DIGITIZED ENVIRONMENTAL DATA Interim Report
David A. Nutile 28 Jun. 1976 78 p refs
(XF52552701; S0164201)
(AD-A027396; NRL-7993) Avail: NTIS HC A05/MF A01 CSCL 20/1

A system of programs has been written in Fortran for obtaining sound speeds in meters per second from digitized depth vs temperature data, in most cases XBT's. Six separate programs were used to allow for human decisions at key steps in the process to ensure reliable results. Archival Nansen-cast data were used to calculate the grouped, avenged salinities. These values, along with the temperature data, are used to calculate sound speed from Leroy's second formula. Report-quality plots of the temperature and sound speed profiles are produced. This report explains the steps used, describes the programs completely, and gives examples of the outputs provided. GRA

N77-15702# New York Univ., N.Y. Courant Inst. of Mathematical Sciences.
A GENERALIZATION OF RESOLUTION
Malcolm C. Harrison and Norman Rubin Mar. 1976 32 p refs
(Contract N00014-75-C-0571)
(AD-A027180) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper defines a generalization of the resolution principle for theorem-proving, which permits a hierarchical organization within the theorem-prover. The generalization corresponds to an extension of the usual unification procedures. A graph-theoretic categorization of sets of clauses with input or unit refutations is given, and completeness theorems are proved in this category. In the case of sets of clauses which include the equality predicate, the generalization gives a new technique for treating equality, for which a completeness theorem is proved. An implementation of these ideas gives results which suggest that this is a more efficient method for treating equality than previously proposed schemes. Author (GRA)

N77-15703# Mitre Corp., Bedford, Mass.
AN AIR FORCE GUIDE TO SOFTWARE DOCUMENTATION REQUIREMENTS
W. L. Schoeffel May 1976 178 p refs
(Contract F19628-76-C-0001; AF Proj. 572H)
(AD-A027051; MTR-3180; ESD-TR-76-159) Avail: NTIS HC A09/MF A01 CSCL 09/2

This guidebook is one of a series covering important aspects of software acquisition management. It is intended for managers and technical personnel who are responsible for determining the documentation requirements for software in a large system acquisition. Software related Air Force technical and management documents are identified, and the most important are described in terms of uses to the procuring activity. Software related documents used by other defense agencies are surveyed as alternatives or models for tailoring Air Force data item descriptions. Author (GRA)

N77-15704# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
UMCOL(UNIVERSAL MINICOMPUTER ORIENTED LANGUAGE): AN INTERMEDIATE LANGUAGE FOR MINICOMPUTER CROSS-COMPILATION M.S. Thesis - Mississippi State Univ.
Joseph Karl Speetjens May 1976 62 p refs
(AD-A026713; AFIT-CI-76-67) Avail: NTIS HC A04/MF A01 CSCL 09/2

With the increasing use of minicomputers, the concept of cross-compilation (source program translated by one machine which in turn outputs object code for another machine) has attracted much interest. This thesis examines the use of an intermediate language, a concept long considered for systems development, as a tool to reduce duplication of effort and encourage communication between cross-compiler writers. Past intermediate language attempts are examined and suggestions are made for a universal minicomputer oriented language design especially for cross-compilation. Author (GRA)

N77-15705# George Washington Univ., Washington, D.C. Program in Logistics.
COMPUTATIONAL EXPERIENCE WITH OPTIMAL VALUE FUNCTION AND LAGRANGE MULTIPLIER SENSITIVITY IN NLP
Robert L. Armacost 10 May 1976 61 p refs
(Contract N00014-75-C-0729; NR Proj. 347-020)
(AD-A026374; T-335) Avail: NTIS HC A04/MF A01 CSCL 15/5

Sensitivity analysis in nonlinear programming is examined using the Sequential Unconstrained Minimization Technique. Particular emphasis is placed on the partial derivatives of the Lagrange multipliers and the optimal value function taken with respect to specified problem parameters, the estimation of which is based on recent developments by Armacost and Fiacco. The computational experience complements that previously reported by Armacost and Fiacco. An application of the sensitivity analysis to a large-scale, multi-item inventory model developed for the U.S. Navy is presented. Author (GRA)

N77-15706# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
MIN: AN INTERACTIVE EDUCATIONAL PROGRAM FOR FUNCTION MINIMIZATION Interim Report
R. Muralidharan and R. K. Jain Dec. 1975 55 p
(Contract N00014-75-C-0648; Grant NSF HES-73-10323;

Proj. 372-012)
(AD-A026835; TR-659) Avail: NTIS HC A03/MF A01 CSCL 09/2

MIN is an interactive computer program package for function minimization. It provides building blocks with which a user can construct a program to solve his problem. Moreover, it is an educational tool which helps users 'learn' what is happening by interacting with the program while it is executing, by testing out his intuition, by switching algorithms between iterations, etc. Currently MIN provides a choice of four search direction algorithms (Davidon Fletcher Powell method, Parallel Tangent Method, Fletcher Reeve's Conjugate Gradient Method, and Gradient Method) and five line search algorithms (Golden Section, False Position, High Order, Fibbonacci and DSC-Powell Search). Also it provides several stopping criterion, different output formats, and proper input checking facilities. The package has been written in BASIC language implemented on WANG 2200 computers. GRA

N77-15707# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
AN INTERPRETER FOR EXTENDED LAMBDA CALCULUS: SCHEME
Gerald Jay Sussman and Guy Lewis Steele, Jr. Dec. 1975 46 p refs
(Contract N00014-75-C-0463)
(AD-A026595; AI-M-349) Avail: NTIS HC A03/MF A01 CSCL 09/2

Inspired by ACTORS the authors have implemented an interpreter for a LISP-like language, SCHEME based on the lambda calculus (Church), but extended for side effects, multiprocessing, and process synchronization. The purpose of this implementation is tutorial. The authors wish to: (1) alleviate the confusion caused by Micro-PLANNER, CONNIVER, etc. by clarifying the embedding of non-recursive control structures in a recursive host language like LISP; (2) explain how to use these control structures, independent of such issues as pattern matching and data base manipulation; (3) have a simple concrete experimental domain for certain issues of programming semantics and style. GRA

N77-15708# Florida Univ., Gainesville. Dept. of Industrial and Systems Engineering.
A NOTE ON SINGLE MACHINE SEQUENCING WITH RANDOM PROCESSING TIMES
Thom J. Hodgson Jun. 1976 9 p refs
(Contract N00014-76-C-0096)
(AD-A026574; RR-76-14) Avail: NTIS HC A02/MF A01 CSCL 09/2

It is shown that Lawler's Efficient (order N2) algorithm for the N job, one machine, scheduling problem, where the objective is to minimize the maximum deferral cost, subject to arbitrary precedence relationships, also applies when the processing times are random variables and the objective is to minimize the maximum expected deferral cost. Several special cases are explored. Author (GRA)

N77-15709# Technion Research and Development Foundation Ltd., Haifa (Israel).
MACRO PROCESSORS FOR EFFICIENT PROGRAM PRODUCTION Final Technical Report
E. Kantorowitz Feb. 1976 21 p refs
(Grant DA-ERO-591-74-G0043; DA Proj. 200-61102-B-14C)
(AD-A026026) Avail: NTIS HC A02/MF A01 CSCL 09/2

Inexpensive macro techniques for fitting of a programming language to specific programming problems are proposed and demonstrated. The special purpose languages implemented by these macro techniques are characterized by high compilation speeds and reasonable error handling. Efficient object code may be achieved. Author (GRA)

N77-15710# RAND Corp., Santa Monica, Calif.
A ROUTING ALGORITHM FOR DIGRAPHS
Edward Bedrosian Jan. 1976 6 p refs
(AD-A026661; P-5574) Avail: NTIS HC A02/MF A01 CSCL 09/2

A new algorithm for routing data packets in networks of computers connected by communication links is given by Chyung and Reddy. Because they assume that the communication links are two-way, their result applies, properly, to routing messages in a graph. However, some communication networks have asymmetrical cross links either by design or because the radio circuits that must be paralleled in opposite directions to compose them may fail. Such networks are represented by digraphs, and it is clear that they require a generalized routing algorith. A simple modification of Chyung and Reddy's routing algorithm, shown below, provides this generalization. GRA

N77-15711# Naval Undersea Center, San Diego, Calif.
LOLA USER'S MANUAL Research and Development Report, Mar. - Jul. 1975
M. S. Ball and D. M. Cottel Feb. 1976 83 p refs
(XF21221701)
(AD-A026102; NUC-TP-517) Avail: NTIS HC A05/MF A01 CSCL 09/2

This document describes the Logic Language Assembler, a computer program developed to aid in the design and implementation of digital logic systems. The circuit components and interconnections are specified with Boolean-like logic equations. The program checks this system specification for inconsistencies, allocates logic functions to circuit components, and produces a list describing the component/pin connections for every signal name. Author (GRA)

N77-15712# Mitre Corp., Bedford, Mass.
USER REQUIREMENTS LANGUAGE AND ANALYZER (URL/URA): AN INSTALLATION GUIDE
L. C. Cheng Jan. 1976 58 p refs
(Contract F19628-75-C-0001; AF Proj. 572H)
(AD-A026127; MTR-3095; ESD-TR-75-360) Avail: NTIS HC A04/MF A01 CSCL 09/2

This document contains instructions for installing URL/URA (User Requirements Language/User Requirements Analyzer) on the IBM 370/158 operating under OS/MVT and Time Sharing Option (TSO). Guidelines are also given for installation in other environments. This document is written for systems personnel who will be responsible for the installation, and they are therefore presumed to be familiar with terminology used. Author (GRA)

N77-15713# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RANDOM VARIABLES AS A DATA TYPE
Alan G. Nemeth 13 May 1976 92 p refs
(Contract F19628-76-C-0002; ARPA Order 2929)
(AD-A026452; TR-516; ESD-TR-76-76) Avail: NTIS HC A05/MF A01 CSCL 09/2

This report discusses the use of random variables as a data type for programming languages. It demonstrates that for complex programs the results of the use of random variables are non-computable. After imposing restrictions on the class of programs to obtain a practical, although limited class of programs, the author discusses major problems of constructing a statistical compiler which accepts distributions for its input variables, and produces the distribution of its output variables. Both simplification rules and representation techniques for such a compiler are described. A simple example of such a compiler which has been implemented is described, and the problems in extending the implementation are explored. GRA

N77-15714# National Bureau of Standards, Washington, D.C. Inst. for Computer Sciences and Technology.
OPERATING SYSTEM STRUCTURES TO SUPPORT SECURITY AND RELIABLE SOFTWARE Final Report
Theodore A. Linden Aug. 1976 50 p refs
(PB-257421/8; NBS-TN-919) Avail: NTIS HC A03/MF A01 CSCL 09B

Security has become an important and challenging goal in the design of computer systems. Two system structuring concepts that support security are considered; namely, small protection domains and extended-type objects. Small protection domains allow each subunit or module of a program to be executed in a restricted environment that can prevent unanticipated or undesirable actions by that module. Extended-type objects provide a vehicle for data abstraction by allowing objects of new types to be manipulated in terms of operations that are natural for these objects. This provides a way to extend system protection features so that protection can be enforced in terms of applications oriented operations on objects. GRA

N77-15715# National Bureau of Standards, Washington, D.C. Inst. for Computer Sciences and Technology.
THE USE OF ABSTRACT DATA TYPES TO SIMPLIFY PROGRAM MODIFICATIONS Final Report
Theodore A. Linden 1976 13 p refs Presented at Conf. on Data: Abstraction Definition and Struct., Salt Lake City, 22-24 Mar. 1976
(PB-257854/0) Avail: NTIS HC A02/MF A01 CSCL 09B

The staged development of a program to compute prime numbers based on the Sieve of Erosthenes is illustrated. An extensive introduction to the concept of abstract data types is included. The paper can be used as a tutorial survey of abstract data types and their use in connection with recent approaches to data abstraction, hierarchical structure, and program design.
GRA

N77-15716# Avco Corp., Wilmington, Mass. Systems Div.
HYPERVELOCITY INFLIGHT TRAJECTORY SCATTER (HITS) CODE, USER'S MANUAL Final Report, Dec. 1975 - Apr. 1976
Robert G. Bellaire and Theodore O. Gustafson Apr. 1976 372 p refs
(Contract DAAA09-74-C-2026; DA Proj. 1W6-62603-AH-78) (AD-A027670; AVSD-0137-76-CR; RIA-R-TR-76-019) Avail: NTIS HC A16/MF A01 CSCL 19/4

This report is a User's Manual for the HITS computer code. The HITS code statistically evaluates projectile dispersion, which is the dispersion associated with the inflight behavior of a gun launched projectile. Projectile dispersion is a fundamental limit on overall weapon system effectiveness. The code is an automated computer-based analytic procedure for computing crossrange and downrange dispersion error budgets and sensitivity coefficients to the sources of projectile dispersion. The error budgets statistically define projectile dispersion at a level conducive to interpretation and comprehensive understanding. Since this report is a User's Manual, the emphasis is placed on providing the information necessary to operate the code and interpret the results. Detailed input/output information is summarized in tables featuring step-by-step cook-book instructions. Example problems are discussed. Appendices present the theoretical and programming fine points, as well as the complete program listing.
GRA

62 COMPUTER SYSTEMS

Includes computer networks.

N77-15717# Stanford Univ., Calif. Electronics Labs.
STUDIES IN THE ORGANIZATION OF COMPUTER SYSTEMS Progress Summary, 1975
Michael J. Flynn Nov. 1975 12 p refs
(Contract AT(04-3)-326)
(SU-326-P39-3) Avail: NTIS HC A02/MF A01

Theoretical and practical methods for the categorization, analysis, and synthesis of computing systems were studied. In particular, an emulation laboratory was developed for the analysis of computer architectures and interpretive computer designs. A study of memory hierarchy management techniques was initiated so as to determine the properties of multilevel virtual memory systems which remain invariant across each level. Efforts in the areas of parallel processors and program representation continued together with a newly initiated study on topology of algorithms.
ERA

N77-15718# California Univ., Livermore. Lawrence Livermore Lab.
MULTI-MINI SYSTEMS: A FUNCTIONAL DEVELOPMENT OF THE ARCHITECTURE FOR TOMORROW'S ADMINISTRATIVE COMPUTING
D. L. Seibel 15 Mar. 1976 33 p refs Presented at Assoc. ERDA Systems, Operations and Programming Conf., Arlington, Va., 30 Mar. 1976
(Contract W-7405-eng-48)
(UCRL-77946; Conf-760325-2) Avail: NTIS HC A03/MF A01

The technology required for a disbursement of computing power is well beyond the capabilities of most installations currently to utilize such a network in an efficient and cost-effective manner. As the industry trend progresses further and further toward these noncentralized facilities, however, it is imperative for DP managers to come to grips with this evolution--and to take steps today to plan and implement these systems of tomorrow carefully. These steps are delineated, and some future technologies which may significantly impact the administrative data processing of tomorrow are projected.
Author (ERA)

N77-15719# Ames Lab., Iowa.
SYSTEMS ANALYSIS GUIDE FOR OS910 VERSION 2: A REAL-TIME OPERATING SYSTEM FOR THE SDS-910 COMPUTER
Leonard C. Moon and Anthony P. Lucido Mar. 1976 67 p
(Contract W-7405-eng-82)
(IS-3860) Avail: NTIS HC A04/MF A01

OS910 Version 2 operating system is a real-time experiment control system for the SDS-910. The SDS-910 is coupled to a DEC PDP-15, where the PDP-15 is the computation element and the SDS-910 is used as an intelligent interrupt handler. The SDS-910 operating system and the communication scheme between the SDS-910 and the PDP-15 are discussed in detail.
ERA

N77-15720# National Bureau of Standards, Washington, D.C.
A PREDICTIVE RESPONSE TIME MONITOR FOR COMPUTER NETWORKS Interim Report, Jun. - Aug. 1975
Sandra A. Mamrak (Ohio State Univ., Columbus) 1976 6 p refs Reprint Presented at Proc. of 3d Intern. Conf. on Computer Commun., Toronto, 3-6 Aug. 1976 p 626-630 Submitted for publication
(PB-257826/8) Avail: NTIS HC A02/MF A01 CSCL 09B

A predictive response time module to assist users of a heterogeneous network of computers was proposed. The network user is able to query this dynamically updated software module to obtain current information relating to the business of time-sharing systems in the network and the amount of time required on these systems to run various classes of computing applications. The implementation of the module was proposed as an extension of a network access machine (NAM) developed by the Computer Networking Section at the National Bureau of Standards. The NAM was a minicomputer which assisted the network user in obtaining network services.
GRA

63 CYBERNETICS

Includes feedback and control theory.
For related information see also *54 Man/System Technology and Life Support*.

N77-15721 Maryland Univ., College Park.
A DESCRIPTION AND ANALYSIS OF THE PAR TECHNIQUE: AN APPROACH TO PARALLEL INFERENCE AND PARALLEL SEARCH IN PROBLEM SOLVING SYSTEMS Ph.D. Thesis
Gerald Alan Wilson 1976 446 p
Avail: Univ. Microfilms Order No. 76-29036

A new representation for knowledge in deductive problem solving and question answering systems is reported that enables both parallel inference and parallel search to be accomplished without the use of either multiprocessing or implicit iteration. The technique is based on the premise that significant benefits can be obtained by making a clear distinction between the structure of information and its specific content. By this it is meant that the manner in which sets of domain objects are combined into larger concepts often has significance apart from the particular domain objects themselves. In order to evaluate the utility of this technique, analytical models of both first order unification and global-EPC-unification are presented.
Dissert Abstr.

N77-15722 State Univ. of New York, Stony Brook.
CONTROL OF LINEAR SYSTEMS WITH NON WHITE NOISE HAVING SMALL CORRELATION TIMES Ph.D. Thesis
Menelaos Lambiris 1976 101 p
Avail: Univ. Microfilms Order No. 76-28050

Linear systems with randomly varying coefficients were examined. In particular the case where the noise can be derived from the white Gaussian case and has small and finite correlation time was examined. First the noise was represented in Stieltges integral form, then the moments equations were found by using iteration techniques and utilizing the fact that the noise terms are active only during a small period of time. For the optimal control problem the first and second moment equations were used, assuming that the control was a deterministic process. Two types of cost functions were used, the first the popular quadratic form and the second the so called terminal cost which was linear. In both cases the terminal time was considered fixed and finite. The control for the quadratic cost was found by using a newly developed iteration procedure for linear systems described by an equation with transport lag. Dissert. Abstr.

N77-15723 New Mexico State Univ., University Park.
INTRODUCTION TO MULTIPLE STATE MULTIPLE ACTION DECISION THEORY AND ITS RELATION TO MIXING STRUCTURES Ph.D. Thesis
Bernard Francis Engebos 1976 61 p
Avail: Univ. Microfilms Order No. 76-28950

The theoretical development as presented was related to that of statistical game theory but with a broader set of objectives. Multiple aspects for the state of nature, and sets of permissible action were allowed, with these actions being capable of simultaneous performance. This lead to the introduction of multiple state multiple action decision theory and its basic framework, the mixing structure. The concept of sensor mixes was defined and related to the possibility of decreasing loss by the spying on the state of nature. The cost of obtaining this information was then balanced against the gain obtained by knowledge of the natural state. A resulting figure of merit may be used to determine the desirability of each sensor mix. Several classes of decision functions are defined which demonstrate the properties a decision function must possess to be considered as desirable. Dissert. Abstr.

N77-15724# California Univ., Livermore. Lawrence Livermore Lab.
AUTOMATING THE DESIGN OF MICROPROCESSOR-BASED REAL TIME CONTROL SYSTEMS
M. N. Matelan 16 Apr. 1976 10 p refs Presented at the Des. Automat. Conf. No. 13, Palo Alto, Calif., 27 Jun. 1976; sponsored by ACM-IEEE
(Contract W-7405-eng-48)
(UCRL-78088; Conf-760609-1) Avail: NTIS HC A02/MF A01

An abstract model of the process of producing these systems is presented. The model indicates three areas of the design problem amenable to automation: the selection and configuration of hardware, the production of software, and the selection of a monitor to maintain real-time integrity of the entire system. The concept of hardware binding is introduced, and it is shown that delaying the point in the design cycle where hardware is functionally bound allows a new approach to machine independence. Techniques which allow expression of repetitive control situations are described, as are methods for automatically selecting a timewise correct monitor. ERA

N77-15725# DARCOM Intern Training Center, Texarkana, Tex.
SOLVING CONTROL PROBLEMS WITH DISCRETE CONTROLS Final Report
Randy J. Schuetz May 1976 73 p refs
(AD-A026407; DARCOM-ITC-02-08-76-019) Avail: NTIS HC A04/MF A01 CSCL 12/1

This paper presents a solution to a class of control problems with discrete controls. The class of problems examined is the one governed by a set of n first order linear ordinary differential equations, subject to a set of m linear constraints (m - n), wherein a given quadratic performance index is to be minimized. The discrete controls appear in the solution as initial values of the differential equations. The procedure is implemented in a computer program, and applied to two example problems. Author (GRA)

N77-15726# Rice Univ., Houston, Tex. Aero-Astronautics Group.
CONVERSION OF OPTIMAL CONTROL PROBLEMS WITH FREE INITIAL STATE INTO OPTIMAL CONTROL PROBLEMS WITH FIXED INITIAL STATE Interim Report
A. Miele and B. P. Mohanty 1975 50 p refs
(Grants AF-AFOSR-2185-72; NSF MPS-75-18488; AF Proj. 9749)
(AD-A026604; AAR-130; AFOSR-76-0175TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper considers optimal control problems involving the minimization of a functional subject to differential constraints, nondifferential constraints, initial conditions, and final conditions. The initial conditions can be partly fixed and partly free. Transformation techniques are suggested, by means of which problems with free initial state are converted into problems with fixed initial state. Thereby, it becomes possible to employ, without change, some of the algorithms already developed for optimal control problems with fixed initial state (for instance, the sequential gradient-restoration algorithm). The transformations introduced are two: (1) a linear transformation and (2) a nonlinear transformation. In the linear-quadratic case, the former preserves unchanged the basic structure of the optimization problem, while this is not the case with the latter. GRA

N77-15727# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
COSYEX: A LINEAR CONTROL SYSTEM EXPERIMENTER Interim Technical Report
R. Muralidharan and R. Case Dec. 1975 52 p refs
(Contract N00014-75-C-0648; Grant NSF HES-73-10323; NR Proj. 372-012)
(AD-A026836; TR-662) Avail: NTIS HC A04/MF A01 CSCL 09/2

COSYEX--an acronym for Control System Experimenter--is a computer program written primarily in Fortran and designed for use on a PDP 11/45 Computer under the Unix Time Sharing System (e.g., the Harvard HRSTS computing system). It is an educational tool which a user can employ to experiment with a control system model he specifies. These experiments on LQG Systems may involve Discretization, Riccati Solutions, Regulation, Simulation, Filtering and Optimization. COSYEX provides an extensive interaction facility to the user in specifying his problem, in supervising his experiments and in controlling his errors. These features make COSYEX a convenient educational tool for control system experimentation. COSYEX is available in DEC tape form which is ready to load and run. GRA

N77-15728# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
EFFICIENT ERROR-CORRECTING SYNTAX ANALYSIS FOR RECOGNITION OF NOISY PATTERNS
S. Y. Lu and K. S. Fu Mar. 1976 31 p refs
(Grant AF-AFOSR-2661-74; AF Proj. 9769)
(AD-A027653; TR-EE76-9; AFOSR-76-0693TR) Avail: NTIS HC A03/MF A01 CSCL 09/4

The use of a stochastic error-correcting parser for recognition of noisy and distorted patterns often results in a process of high accuracy, but with low efficiency. In this paper stochastic error-correcting parsers are formulated to include substitution, addition, and deletion errors. In order to make the syntax analysis practically feasible, a sequential classification algorithm with error-correcting capability is proposed. Considerable amount of parsing time can be saved by using the sequential algorithm. Computational results based on the classification experiments of noisy patterns for both non-sequential and sequential error-correcting parsers are presented. GRA

N77-15729# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
PROPOSAL TO THE ADVANCED RESEARCH PROJECTS AGENCY
Patrick H. Winston May 1976 122 p
(Contract N00014-75-C-0643)
(AD-A026709; AI-M-366) Avail: NTIS HC A06/MF A01 CSCL 09/2

This is the substance of a proposal submitted in June, 1975, for research in the areas of large data bases and intelligent terminals, applications of machine vision and manipulation, basic

studies in Artificial Intelligence, and LISP machine development. Author (GRA)

N77-15730# Clemson Univ., S.C. Dept. of Mathematical Sciences.
A CLASS OF MULTIPLE DECISION RULES
Khursheed Alam and K. T. Wallenius Jun. 1976 14 p refs
(Contract N00014-75-C-0451; NR Proj. 042-271)
(AD-A026279; TR-224) Avail: NTIS HC A02/MF A01 CSCL 12/1

For the problem of selecting the best population among several populations the intuitively natural selection rule is known to be optimal for a large class of loss functions and a family of distributions with monotone likelihood ratio property. In this paper a certain class of selection rules is considered, and an optimal rule within the class is derived for an extended family of distributions. GRA

N77-15731# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
FROM UNDERSTANDING COMPUTATION TO UNDERSTANDING NEUTRAL CIRCUITRY
D. Marr and T. Poggio May 1976 24 p refs
(Contract N00014-75-C-0643)
(AD-A026875; AI-M-357) Avail: NTIS HC A02/MF A01 CSCL 06/4

The CNS needs to be understood at four nearly independent levels of description: (1) that at which the nature of a computation is expressed; (2) that at which the algorithms that implement a computation are characterized; (3) that at which an algorithm is committed to particular mechanisms; and (4) that at which the mechanisms are realized in hardware. In general, the nature of a computation is determined by the problem to be solved, the mechanisms that are used depend upon the available hardware, and the particular algorithms chosen depend on the problem and on the available mechanisms. Examples are given of theories at each level. Author (GRA)

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N77-15732 Rochester Univ., N.Y.
SOME RESULTS IN RE PRESENTED VECTOR SPACES Ph.D. Thesis
Elton Kurt Tekolste 1976 49 p
Avail: Univ. Microfilms Order No. 76-24028

Recursively enumerable subspaces of a recursively presented infinite dimensional vector space with a dependence algorithm and a recursive ground field are analyzed. It is shown that the quotients of V infinity with respect to its recursively enumerable subspaces range, up to recursive isomorphism, over all r.e. presented vector spaces over the ground field. The dependence relation of a subspace V is the set of finite sequences of vectors which are dependent modulo V. A t-section of the dependence relation is the set of sequences in the dependence relation of length t + 1. Any infinite dimensional r.e. subspace W contains a subspace V which has finite co-dimension in W and such that the t-sections are recursive up to any desired T(0), and of degree at least that of W for t greater than T(0). Dissert. Abstr.

N77-15733 North Carolina State Univ., Raleigh.
STRONGLY HARMONIC ALGEBRA AND ITS SHEAF REPRESENTATION Ph.D. Thesis
Sun Hae Kim 1976 85 p
Avail: Univ. Microfilms Order No. 76-28495

Let R be an A-algebra, where A is a ring with identity and R^* be the A-algebra obtained by adjoining a unit to R by the aid of A. Then R is said to be strongly harmonic A-algebra iff for any M,N, in set Mu(R^*) with M does not equal N and R is not contained in M. There exist ideals alpha, beta in R^* such that alpha is not contained in M, beta is not contained in N, and alpha beta equals beta alpha equals zero, where Mu set (R^*) is the maximal spectrum of R^* with hull kernel topology. It is shown that tauberian theorems are generalized to the strongly harmonic algebras. Dissert. Abstr.

N77-15734 North Carolina State Univ., Raleigh.
PERIODIC SOLUTIONS FOR DIFFERENTIAL EQUATIONS IN A BANACH SPACE Ph.D. Thesis
James Horn Lightbourne, III 1976 103 p
Avail: Univ. Microfilms Order No. 76-28498

A growth estimate on the measure of noncompactness of trajectories of approximate solutions is presented. This estimate is employed to obtain existence of periodic solutions to (IVP). The existence of solutions and of periodic solutions to (IE) was also investigated. Applications to nonlinear perturbations of systems of certain parabolic and hyperbolic equations are indicated. Dissert. Abstr.

N77-15735 Michigan Univ., Ann Arbor.
A LEAST SQUARES DECOMPOSITION METHOD FOR THE NUMERICAL SOLUTION OF ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS Ph.D. Thesis
Dennis Charles Jespersen 1976 89 p
Avail: Univ. Microfilms Order No. 76-27501

The convergence properties of a certain method for the numerical solution of partial differential equations were studied. The method involved introducing the derivatives of the (unknown) solution as new independent variables and numerically solving the resulting system of partial differential equations by least squares techniques. The essential theoretical tools were a priori inequalities from the theory of partial differential equations and approximation theoretic properties of finite element spaces. The main interest was in a priori bounds for the difference between the approximate and exact solutions. Application of the least squares method to a genuine system of equations was considered. A specific system, the equations of two-dimensional elasticity, was considered, and optimal error estimates were proven. Dissert. Abstr.

N77-15736 Louisiana State Univ. and A&M Coll., Baton Rouge.
QUASI-LINEAR EVOLUTION EQUATIONS IN BANACH SPACES Ph.D. Thesis
Michael George Murphy 1976 49 p
Avail: Univ. Microfilms Order No. 76-28821

The quasilinear evolution equation in a Banach space setting is studied. Fundamental results concerning linear evolution equations are presented. Calculus in Banach spaces, the analytical theory of semigroups of bounded linear operators, and background material from the theory of linear evolution equations in Banach spaces are also included. Dissert. Abstr.

N77-15737 Kentucky Univ., Lexington.
GRADED STRUCTURES IN COMMUTATIVE ALGEBRA Ph.D. Thesis
Jon Lee Johnson 1976 77 p
Avail: Univ. Microfilms Order No. 76-28110

The development of an analog of valuation rings is discussed. Results obtained deal with the structure of these rings and also with developing analogs of the classical results of valuation theory. A good number of examples are included to show that classical theorems need not have graded analogs. Dissert. Abstr.

N77-15738 Oregon Univ., Eugene.
REALITY AND ZERO SET THEOREMS FOR REAL ANALYTIC AND DIFFERENTIABLE FUNCTIONS Ph.D. Thesis
William Allen Adkins 1976 136 p
Avail: Univ. Microfilms Order No. 76-27622

The nullstellensatz problem for algebras of global real analytic functions, and for ideals of differentiable functions generated by real analytic functions, was studied. The nullstellensatz problem for an algebra of real or complex valued functions on some space is the problem of determining in some explicit manner all the functions in the algebra which vanish on the zeros of an ideal of the algebra. This problem is solved for algebras of real analytic functions on two dimensional real analytic manifolds and for analytic ideals of differentiable functions on any real analytic manifold. In addition to the material on the nullstellensatz, the background material on real commutative algebra is developed and a dimension theorem for real algebraic varieties is proved. There are results on finitely generated ideals of differentiable

functions and on unique factorization for algebras of real analytic functions. Dissert. Abstr.

N77-15739# Cincinnati Univ., Ohio. Dept. of Engineering Analysis.
DYNAMICS OF GENERAL CHAIN SYSTEMS Final Technical Report, 1 Jan. 1974 - 30 Jun. 1976
Ronald L. Huston and Chris E. Passarello Aug. 1976 34 p refs
(Grant NSF GK-41272)
(PB-257183/4; UC-EC-080176-5-NSF) Avail: NTIS HC A03/MF A01 CSCL 20K

A number of ideas for obtaining efficient computer algorithms for obtaining and solving the governing kinematical and dynamical equations of large mechanical systems (general chain systems or open trees) are presented and discussed. These ideas include the notions of relative coordinates, quasi-coordinates, Euler parameters, Lagrange's form of d'Alembert's principle, and body connection array matrices. A general procedure for deriving the governing equations using these ideas is presented. GRA

N77-15740# Wisconsin Univ., Madison. Dept. of Statistics.
REPRODUCING KERNEL HILBERT SPACES APPLIED TO BIVARIATE NATURAL SPLINE DENSITY ESTIMATION
Robert M. Kuhn Sep. 1974 26 p refs
(Grant AF-AFOSR-2363-72; AF Proj. 9769)
(AD-A026328; UWIS-DS-74-435; AFOSR-76-0726TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

The purpose of this technical report is to introduce and describe the properties of a bivariate density estimation procedure which is a generalization of the univariate procedure.
Author (GRA)

N77-15741# Wisconsin Univ., Madison. Dept. of Statistics.
TOPICS IN TIME SERIES ANALYSIS. 3: ARIMA TIME SERIES MODELS WITH NON-NORMAL SHOCKS Interim Report
Johannes Ledolter and George E. P. Box Jan. 1976 42 p refs
(Grant AF-AFOSR-2363-72; AF Proj. 9769)
(AD-A026312; UWIS-DS-76-448; AFOSR-76-0725TR) Avail: NTIS HC A03/MF A01

In this paper the parent distribution of the shocks a sub t in ARIMA models is extended to the family of symmetric exponential power distributions, which covers the Normal as well as particular forms of symmetric leptokurtic and playkurtic distributions. The inference robustness of the parameters of ARIMA models and the effect of non Normality of the shocks on the forecasts are studied. Author (GRA)

N77-15742# Watervliet Arsenal, N.Y. Benet Weapons Lab.
EXTERIOR COLLOCATION FOR THREE DIMENSIONAL SURFACE FLAWS
M. A. Hussain, R. F. Haggerty, and B. Noble 1976 15 p refs
(AD-A026048) Avail: NTIS HC A02/MF A01 CSCL 20/11

A method of three dimensional boundary collocation has been presented in the paper. The method gives satisfactory results for a penny shaped crack in a block in comparison with the exact solution of the crack in an infinite medium. In the application of this method to a part-circular surface crack in a block, the condition of vanishing normal stress at points of crack-free surface intersection gives significant lower stress intensity factors by the present method than previously reported results at points close to the free surface. At points where the effect of free surface is small, the results obtained by collocation method are in good agreement with results by other methods. Using a simple simulation stress intensity factors for a circular surface flaw in a thick walled cylinder were obtained which are in excellent agreement with extensive experimental results. The method can be extended to other complicated geometries under arbitrary loading conditions. Author (GRA)

N77-15743# Aerospace Corp., El Segundo, Calif. Guidance and Control Div.
THE TRANSFORMATION OPERATOR APPROACH TO MULTI-BODY DYNAMICS
William Jerkovsky 10 May 1976 68 p refs
(Contract F04701-75-C-0076)
(AD-A027101; TR-0076(6901-03)-5; SAMSO-TR-76-1) Avail: NTIS HC A04/MF A01 CSCL 20/11

This report describes an algebraical formulation of the classical dynamics of a system composed of several subsystems. This new approach to dynamics is based on Kron's method of subspaces, and it is particularly convenient for spacecraft dynamics formulations. The report consists of three parts: the first part presents the theoretical development, and the subsequent two parts present examples and applications. GRA

N77-15744# Syracuse Univ., N.Y.
TESTS FOR UNIVARIATE AND MULTIVARIATE NORMALITY
K. G. Mehrotra and J. E. Michalek Griffiss AFB, N. Y. RADC May 1976 66 p refs
(Contract F30602-75-C-0121; AF Proj. 9567)
(AD-A026410; RADC-TR-76-140) Avail: NTIS HC A04/MF A01 CSCL 12/1

Brief descriptions of some tests of goodness of fit applicable to the assumption of normality are presented. Tests are given for univariate as well as multivariate normality. A summary of their power properties is given. Author (GRA)

N77-15745# DARCOM Intern Training Center, Texarkana, Tex.
PROGRESSION WITH DIFFERENTIAL EQUATION MODELS Final Report
Craig D. Hunter Apr. 1976 100 p refs Prepared in cooperation with Texas A and M Univ., Texarkana
(AD-A026446; DARCOM-ITC-02-08-76-008) Avail: NTIS HC A05/MF A01 CSCL 12/1

Regression analysis normally implies the use of algebraic equations to describe a system; however, some cases would better be modeled by differential equations. This is accomplished by assuming a differential equation model for a given set of data and estimating the values of the unkown parameters within the model. These values are then systematically perturbed to generate particular solutions which are superimposed to yield a better estimate of the unknowns. This process is repeated until a specified accuracy is met. Through an analysis of variance, the statistical characteristics of linear regression can be generated for most nth order differential equations. This provides a basis for evaluating the 'acceptance or rejection' of the regression. The characteristics generated consist of an ANOVA table (uncorrected), general F test on the regression, the R2 value, covariance matrix of the superposition constants, an estimate of the variance about the regression, an estimate of the variance of the parameters, and the confidence intervals on these estimates. Author (GRA)

N77-15746# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A CLASS OF NONPARAMETRIC ESTIMATORS OF REGRESSION COEFFICIENTS IN AN AUTOREGRESSIVE SCHEME Ph.D. Thesis
Richard Wayne Kulp May 1976 108 p refs Prepared in cooperation with Texas Tech. Univ., Lubbock
(AD-A026704; AFIT-CI-76-60) Avail: NTIS HC A05/MF A01 CSCL 12/1

This dissertation is concerned with estimation of parameters of an autoregressive process. In Chapter II, some results from least squares estimation are presented for linear input-output systems and multiple autoregressive processes when the residual sequence may have infinite variance. A restricted survey of some of the literature in this vast area is also presented in the introduction to Chapter II. Chapter III contains two nonstandard estimators for the regression coefficient in the linear Markov process. Both of the estimators are shown to be unbiased and to have normal limiting distributions. The asymptotic relative efficiencies (A.R.E.) of these estimators versus least squares estimators are presented in Chapter IV. We propose an iterative scheme for estimating the regression coefficients in the general A.R.(p) process in Chapter V. Monte Carlo simulations are done for the estimators presented in Chapter II and for the estimator theta of Chapter III. These results are reported in Chapters II and IV. Simulations for the A.R.(2) process are given in Chapter IV. Chapter VI summarizes the work accomplished and suggests further research. GRA

N77-15747# Naval Postgraduate School, Monterey, Calif.
REDUCED ORDER APPROXIMATIONS TO HIGHER ORDER LINEAR SYSTEMS M.S. Thesis
Jerry Dennis Thompson Jun. 1976 81 p refs
(AD-A027246) Avail: NTIS HC A05/MF A01 CSCL 12/1

Low order models are derived by a computer program technique which utilizes the Routh Approximation Method of analysis. Comparisons are made between this method and that of the Dominant Pole Method and the Iterative Optimization Method of analysis. Low order models are developed from higher-order linear systems and compared to that system in response to input excitations consisting of a Step and a Ramp. Graphical displays and numerical tables provide a basis for error analysis and comparisons between the approximation techniques. Author (GRA)

N77-15748# Wisconsin Univ., Madison. Dept. of Statistics.
TOPICS IN TIME SERIES ANALYSIS. 1: REVIEW OF TIME SERIES MODELS AND THEIR FORECASTS Interim Report
Johannes Ledolter and George E. P. Box Dec. 1975 22 p refs
(Grant AF-AFOSR-2363-72; AF Proj. 9769)
(AD-A026311; UWIS-DS-75-446; AFOSR-76-0724TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper provides a summary of the literature concerned with time series analysis and forecasting. We discuss the probabilistic foundations of time series analysis, the linear prediction theory, the general linear process, its parsimonious versions and their prediction. Furthermore, the philosophy of iterative model building and exponential smoothing techniques are discussed. Author (GRA)

N77-15749# Wisconsin Univ., Madison. Mathematics Research Center.
THE HOPF BIFURCATION THEOREM Technical Summary Report
Michael G. Crandall and Paul H. Rabinowitz Apr. 1976 56 p refs Sponsored in part by Army Res. Office and ONR
(AD-A026221; MRC-TSR-1604) Avail: NTIS HC A04/MF A01 CSCL 12/1

The Hopf Bifurcation Theorem concerns the bifurcation of a family of time periodic solutions of an evolution equation from a family of equilibrium solutions. Both finite and infinite dimensional versions of this theorem are given in this paper. Symmetry properties and the linearized stability of these solutions are also studied. Author (GRA)

N77-15750# North Carolina Univ., Chapel Hill. Dept. of Statistics.
A NOTE ON THE JOINT DISTRIBUTION OF THE DURATION OF A BUSY PERIOD AND THE TOTAL QUEUEING TIME
Walter L. Smith Jun. 1976 13 p refs
(Contract N00014-76-C-0550)
(AD-A026445; Mimeo-Ser-1072) Avail: NTIS HC A02/MF A01 CSCL 05/3

Let Z sub 1 be total time lost by customers in a busy period of duration U in an M/M/1 queue. A formula is obtained for the joint Laplace transform of Z and U, and product moments of these quantities are given up to those of order three. Author (GRA)

N77-15751*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
CLOSED-LOOP STRUCTURAL STABILITY FOR LINEAR-QUADRATIC OPTIMAL SYSTEMS Interim Report
Poh Kam Wong and Michael Athans Dec. 1975 29 p refs Presented at the IEEE Conf. on Decision and Control, 1976 Submitted for publication
(Grants NGL-22-009-124; AF-AFOSR-2273-72; AF Proj. 9769) (NASA-CR-149202; AFOSR-76-0559TR; AD-A025183; ESL-P-641) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper contains an explicit parameterization of a subclass of linear constant gain feedback maps that never destabilize an originally open-loop stable system. These results can then be used to obtain several new structural stability results for multi-input linear-quadratic feedback optimal designs. Author (GRA)

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N77-15752 Yale Univ., New Haven, Conn.
TRUNCATED GENERALIZED BAYES TESTS Ph.D. Thesis
Gokul Damodar Ghia 1976 78 p
Avail: Univ. Microfilms Order No. 76-29213

Omega sub 1 is assumed to be partitioned into a finite number of subspaces, on each of which the ordering of chi is complete. The complete class then specified has applications to one parameter families. Next it is assumed that omega sub 1 has countably many subspaces with an ordering of chi relative to each; in this case new complete class results are obtained, which apply to certain multiparameter families. Under certain additional restrictions the complete class specified is minimal. The complete class is in fact shown to consist of truncated generalized Bayes tests; that is tests which are generalized Bayes in the class of tests which reject H sub 0 for x not in a set C, where C lies in a class of subsets of chi depending on f sub x(alpha). The multiparameter exponential family as well as certain non exponential families are shown to satisfy the criteria under which the complete class specification is valid. Dissert. Abstr.

N77-15753 Wisconsin Univ., Madison.
SELECTING LOWER DIMENSIONAL HYPERPLANES IN MULTIVARIATE ANALYSIS Ph.D. Thesis
Raul Alfredo Hudlet-Yanez 1976 143 p
Avail: Univ. Microfilms Order No. 76-20114

Three techniques of multivariate analysis are considered, they are principal components, canonical correlations, and discriminant analysis. In general, a partial ordering based on non-negativity was established among the residual covariance matrices. No solution exists which makes the residual covariance matrix as small as possible with respect to this partial ordering, but a minimal complete class does exist. The structure of the class is studied in detail. Dissert. Abstr.

N77-15754 Rutgers Univ., New Brunswick, N.J.
AN EVALUATION AND COMPARISON OF DISCRIMINATION PROCEDURES FOR CERTAIN TYPES OF NON-NORMAL DISTRIBUTIONS Ph.D. Thesis
Stephen Lawrence Koffler 1976 268 p
Avail: Univ. Microfilms Order No. 76-27330

The relative efficiency of certain alternatives to the linear discriminant function for non-normal data was studied by using Monte Carlo methods to simulate three types of non-normal distributions. The three distributions were generated from the normal distribution by using certain nonlinear transformations. The three types of non-normal distributions are: (1) Logit normal (finite range distribution); (2) log normal (semi-infinite range distribution); also (3) inverse hyperbolic sine normal (infinite range distribution). For all situations, independent variables are considered for both a two and three dimensional model for two population discrimination problem. The results show that the linear discriminant function's performance is poorer than other types of procedures in terms of proportions of misclassifications when the samples are drawn from non-normal distributions. Dissert. Abstr.

N77-15755 Minnesota Univ., Minneapolis.
RANDOMIZATION ANALYSIS OF THE GENERAL REPEATED MEASURES DESIGN Ph.D. Thesis
Robert Clayton Larson 1976 274 p
Avail: Univ. Microfilms Order No. 76-27950

General formulas for expected values of mean squares under randomization were derived for four types of repeated measures designs. These EMS represent averages of all sample mean squares that are possible under sampling of experimental units and factors, and randomization of treatments to units for the particular repeated measures design being considered. The foundation and rationale for randomization analysis is presented, and linear models were studied. A description of the algebraic procedures is given, and guidelines for obtaining EMS for special configurations of fixed and random factors are included. Dissert. Abstr.

N77-15756 Missouri Univ., Rolla.
ON ESTIMATING FUNCTIONALS OF PROBABILITY DENSITIES AND APPLICATIONS TO PARAMETER ESTIMATION Ph.D. Thesis
Dolores Marie Halper Tichenor 1976 127 p
Avail: Univ. Microfilms Order No. 76-26871

Estimating the reciprocal of a scale parameter by means of frequency moments was investigated. An investigation of the bias and mean squared error was carried out, and practical methods for implementing the method of frequency moments in the case of the Cauchy distribution were considered. A two-step estimation procedure was proposed, and a comparison of a one-step and two-step procedure was made. Uniform and normal distributions were considered as prior distributions for the interval width in the frequency moments method, and mean squared error was tabulated. Dissert. Abstr.

N77-15757 State Univ. of New York, Buffalo.
ROBUST CALIBRATION AND RADIOIMMUNOASSAY Ph.D. Thesis
James Julius Tiede 1976 213 p
Avail: Univ. Microfilms Order No. 76-26570

Three aspects of the statistical analysis of radioimmunoassay were investigated. First, a family of curves was proposed for use as a mathematical model of the radioimmunoassay calibration curve. This family of curves was such that only a minimal number of general assumptions were required of the data. Then, in order to estimate the parameters of the calibration model in the most optimum fashion, an algorithm for robust nonlinear regression was created and applied to clinical data. Finally, a procedure for obtaining interval estimates of the substance of interest was presented. The validity of the procedures presented was verified through analysis of clinical and simulation data. Dissert. Abstr.

N77-15758 California Univ., Los Angeles.
A STUDY OF SEQUENTIAL HYPOTHESIS TESTING FOR SYSTEM IDENTIFICATION Ph.D. Thesis
Henry Gleed Nebeker 1976 125 p
Avail: Univ. Microfilms Order No. 76-26893

The application of sequential hypothesis testing to system identification was investigated. A linear Gauss-Markov system model was assumed in which the system parameters and possibly the system order were unknown. All the unknown parameters were included in a parameter vector which can also incorporate unknown system order. The true parameter vector was assumed to be a member of a finite set of possible vectors, or hypotheses. A sequential hypothesis test based on the observations of the system was used to determine the true parameter vector. The test was recursive so that this method is suited for on-line identification. An estimate of the expected number of observations to identify a system, with a given probability of error, was analytically developed. The accuracy of this estimate was verified by comparison with Wald's equation for the special class of systems for which Wald's equation applies. Dissert. Abstr.

N77-15759 Cincinnati Univ., Ohio.
PROBABALISTIC INTEGER PROGRAMMING Ph.D. Thesis
Christopher John Ritz 1976 157 p
Avail: NTIS Avail: Univ. Microfilms Order No. 76-26761

The program is solved through the tangential approximation of the objective function and the solution of a series of binary linear programs. Successive solutions are shown to provide a monotonically increasing lower bound for the nonlinear minimization. After evaluating an extraordinarily small proportion of the feasible solutions, an optimum solution to the surrogate problem, and thus the stochastic binary program, is determined. Dissert. Abstr.

N77-15760 Rensselaer Polytechnic Inst., Troy, N.Y.
ROBUST DATA ANALYSIS BASED ON CHARACTERISTIC FUNCTIONS Ph.D. Thesis
Arlyn David Schumaker 1976 112 p
Avail: Univ. Microfilms Order No. 76-27208

The usefulness of the characteristic function in the area of data analysis, specifically robust estimations, was researched. By investigating the minimization over the distributional parameters of the integral of the weighted squared modulus of the difference between the theoretical and empirical characteristic function, a relatively simple fixed point procedure was obtained for the estimation of the parameters of univariate sample data using the underlying assumption of normality. Sensitivity and influence curves and breakdown analysis indicated the robustness qualities of the estimates. The procedures were extended to the multivariate normal parameter estimation problem and were shown to obtain robust estimates of location, scale and correlation. Finally, the univariate procedure was applied to the general linear regression problem by minimizing the scale estimate of the residual under the hypothesized model. Dissert. Abstr.

N77-15761 Minnesota Univ., Minneapolis.
ABSOLUTE CONTINUITY OF STOCHASTIC PROCESSES IN ABSTRACT WIENER SPACE WITH APPLICATIONS TO INFINITE-DIMENSIONAL FILTERING Ph.D. Thesis
David Alan Rhoades 1976 171 p
Avail: Univ. Microfilms Order No. 76-27926

Results on stochastic processes in Hilbert space and Banach space which are relevant to continuous time filtering problems where both the signal and observation processes are infinite-dimensional were examined. Weak stochastic processes on Hilbert space were considered, and stochastic integrals were defined with respect to weak Brownian motion which were themselves weak processes. These were later used to model the observation noise in the filtering problem. Non-anticipative representations of equivalent Gaussian processes in Banach space were studied, and it was shown that any Banach space valued Gaussian process equivalent to Brownian motion has a non-anticipative representation with respect to Brownian motion. Conditions were found for the absolute continuity of measures associated with diffusion-type processes in abstract Wiener space. Dissert. Abstr.

N77-15762 New York State Univ., Binghamton.
ON STOCHASTIC APPROXIMATION Ph.D. Thesis
Hari Gopal Mukerjee 1977 72 p
Avail: Univ. Microfilms Order No. 76-28866

A weak ergodic property of the Robbins Monro process for approximation is proved. Two stochastic procedures are introduced for approximation when m is assumed to be non-decreasing. The consistency of the estimate is shown. A method is given for estimating theta using isotonic regression. Asymptotic properties of the estimate are given. An analog of the law of iterated logarithm for the Robbins Monro process is proved under appropriate distributional and model assumptions. Dissert. Abstr.

N77-15763# Army Recruiting Command, Fort Sheridan, Ill.
ANALYSIS OF MULTIVARIATE SENSOR RESPONSES IN A SURVEILLANCE ENVIRONMENT
John D. Howard 1976 12 p refs
(AD-A026045) Avail: NTIS HC A02/MF A01 CSCL 09/2

The purpose of this paper is to develop a methodology for analyzing surveillance sensor signals and to translate this analysis into decision rules. The use of Bayesian statistical techniques provides a powerful tool for a quantitative approach to decision making, especially when the analyst has the opportunity to observe or sample prior to making any judgements. The increased reliance placed on using a variety of sensors as an early warning system on the modern battlefield dictates the use of more sophisticated mathematical methods to digest the information sent by these devices. The most recent example of this has occurred in the Middle East where the presence of a U.S. surveillance team is an integral facet of an interim Egyptian-Israeli settlement. The September 1975 settlement engineered by Kissinger's diplomatic shuttle provided for a U.S. Sinai Field Mission near the Mitla and Giddi Passes to monitor military movements of Israel and Egypt. This force has the potential for providing surveillance of not only the key passes but also of the entire length of the U.S. Buffer Zone, from the Mediterranean Sea to the Gulf of Suez. GRA

N77-15764# Wisconsin Univ., Madison. Dept. of Statistics.
TWO RELATED GOODNESS-OF-FIT PROBLEMS WITH APPLICATIONS TO SPACINGS
Guido E. DelPino and Michael A. Stephens Sep. 1975 11 p refs
(Contract N00014-67-A-0112-0085; Grant AF-AFOSR-2362-72)
(AD-A026329; UWIS-DS-75-436; AFOSR-76-0727TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper shows the connection between two problems concerning goodness of fit. One of them has been of interest for a long time; the other has been given attention only recently. We exploit the connection to apply known results for the first problem to the second. GRA

N77-15765# Florida State Univ., Tallahassee. Dept. of Statistics.
DISTORTED POISSON PROCESSES
P. F. Thall and R. J. Serfling Apr. 1976 48 p refs
(Contracts N00014-67-A-0235-0006; N00014-75-C-0551; N00014-76-C-0608)
(AD-A026317; FSU-Statistics-M375; ONR-TR-105) Avail: NTIS HC A03/MF A01 CSCL 12/1

A new family of Poisson cluster processes, called distorted Poisson (DP) processes, is introduced and shown to generalize the (stationary) Gauss-Poisson family. Representations of the DP processes in terms of the probability generating functional are developed and utilized as tools to derive various qualitative and quantitative properties of the DP family. The qualitative properties include: stationarity, orderliness, closure under superposition, translation and deletion, infinite divisibility, mixing, ergodicity. The quantitative properties are: moments; variance and covariance functions; index of dispersion; waiting time distributions; recursion formulas for count probabilities; asymptotic normality of counts. Applications of the DP model are discussed, including its role in connection with robust estimation in a Poisson process. The role of the DP family is assessed in general and in comparison with the Bartlett-Lewis and Neyman-Scott families of Poisson cluster processes. Author (GRA)

N77-15766# Florida State Univ., Tallahassee. Dept. of Statistics.
SOME ELEMENTARY RESULTS ON POISSON APPROXIMATION IN A SEQUENCE OF BERNOULLI TRIALS
R. J. Serfling Apr. 1976 30 p refs
(Contract N00014-76-C-0608)
(AD-A026316; FSU-Statistics-M374; ONR-TR-104) Avail: NTIS HC A03/MF A01 CSCL 12/1

In a finite series of independent success-failure trials, the total number of successes has a Binomial probability distribution. It is a classical result that this probability distribution is subject to approximation by a Poisson distribution if the number of trials is sufficiently large and the probability of success in a trial is sufficiently small. Recent interest has focused upon the cases of trials which are possibly dependent, or which have possibly differing success probabilities, or which have more than two possible outcomes. Further, in connection with appropriate metrics for measuring the disparity between two probability distributions, the problem of bounds on the error of approximation has received attention. The present article provides a unified treatment of some of the more elementary of these recent developments. The aim is to offer a springboard for heightened utilization of the Poisson approximation in probability analysis, both theoretical and applied, a source for up-to-date teaching on the subject, and introduction to a field of research that continues to be interesting and fruitful. The paper also briefly discusses some recent varieties of application of the Poisson approximation, in connection with reliability theory, stochastic processes, urn models, covering problems, and chain letter schemes. Author (GRA)

N77-15767# Florida State Univ., Tallahassee. Dept. of Statistics.
TREATMENT CONTRASTS IN PAIRED COMPARISONS: CONVERGENCE OF A BASIC ITERATIVE SCHEME FOR ESTIMATION
A. T. El-Helbawy (Cairo Univ.) and Ralph A. Bradley Dec. 1975 19 p refs
(Contract N00014-75-C-0551)
(AD-A026315; FSU-Statistics-M349; ONR-TR-100) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper considers the iterative method. It is proved that, subject to a mild condition, the iterative scheme converges to a solution of the likelihood equations that is unique and yields the maximum of the likelihood function on a parameter space constrained by the condition that certain treatment contrasts are null. GRA

N77-15768# Florida State Univ., Tallahassee. Dept. of Statistics.
A NOTE ON APPLICATION OF A LEMMA OF BILLINGSLEY
Mike Longnecker and R. J. Serfling Feb. 1976 8 p refs
(NR Proj. 042-344)
(AD-A026313; FSU-Statistics-M371; TR-103-ONR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Billingsley (1968) provided an important probability inequality of maximal type. This note provides an auxiliary lemma which usefully extends the domain of immediate application of Billingsley's lemma. Some of these applications are pointed out. Author (GRA)

N77-15769# Naval Postgraduate School, Monterey, Calif.
AN INVESTIGATION OF THE PROBABILITY DISTRIBUTION OF THE RIDGE REGRESSION ESTIMATOR FOR LINEAR MODELS M.S. Thesis
Edgar Barry Lewis Mar. 1976 38 p refs
(AD-A026457) Avail: NTIS HC A03/MF A01 CSCL 12/1

The estimation of the parameters of a linear statistical model is generally accomplished by the method of least squares. However, when the method of least squares is applied to nonorthogonal problems the resulting estimates may be significantly different from the true parameters. The method of ridge regression may provide better estimates in these cases; however, a probability distribution of the ridge estimator is presently not known. The form of such a distribution is dependent upon how the ridge parameter, k, is selected. Two possible objective methods of choosing k are examined to determine if either one leads to a useful probability distribution. GRA

N77-15770# Naval Postgraduate School, Monterey, Calif.
STOCHASTIC DECISION MODEL FOR ARITHMETIC PROGRAMMING M.S. Thesis
Ul Haque Mar. 1976 67 p refs
(AD-A026459) Avail: NTIS HC A04/MF A01 CSCL 12/2

Few if any validated guidelines exist for making decisions about the design, media, or format of new instructional products. This study examined strings of programmed learning responses to create general guidelines for making such decisions. Using a Markov model, tables were developed relating the expected proportion of students to be in a solution state at a given accuracy level and at a given level of confidence with respect to the length of response strings. GRA

N77-15771# North Carolina Univ., Chapel Hill.
MAXIMUM LIKELIHOOD ESTIMATION OF THE DISTRIBUTION OF THE SUM OF THREE INDEPENDENT EXPONENTIAL RANDOM VARIABLES
George S. Fishman May 1976 30 p refs
(Contract N00014-67-A-0321-0008)
(AD-A026851; TR-76-7) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper describes a procedure for computing the maximum likelihood estimates of the parameters of the distribution of the sum of three independent exponential random variables. By fitting sample interevent time data from a real system to this distribution, one can create a simulation of the system that exploits the regenerative representation of queueing systems to analyze the simulation's output by relatively elementary statistical methods. The paper also describes computation of the sample asymptotic covariance matrix and an implementation of the likelihood ratio for testing six hypotheses that are special cases of interest. A set of FORTRAN subroutines for executing these procedures appears in the appendix. Author (GRA)

N77-15772# California Univ., Berkeley. Operations Research Center.
APPROXIMATIONS IN MULTI-SERVER POISSON QUEUES
Shirley A. Nozaki and Sheldon M. Ross Apr. 1976 24 p refs
(Contract N00014-75-C-0781; Grants DAHC04-75-G-0163; DAAG29-76-G-0042; NR Proj. 042-238)
(AD-A026304; ORC-76-10) Avail: NTIS HC A02/MF A01 CSCL 12/2

Our major objective is to obtain an approximation for the average time spent waiting in queue by a customer in an M/G/k queueing system--call it W sub Q. This is done by means of an

approximation assumption presented, which is shown to be asymptotically valid both in heavy and in light traffic. The approximation assumption is used to derive an approximation for W sub Q. Numerical comparison with tables given by Hillier-Lo in the special case of Erlang service times indicates that the approximation, which depends on the service distribution only through its first two moments, works remarkably well. In addition, as a by-product of our analysis, we also obtain approximations for the distribution of the number of busy servers and the mean length and number of customers in a busy period. These latter approximations depend on the service distribution only through its mean. The approximation assumption is valid and leads to the exact result in the case of a limited capacity system where no queue is allowed to form. GRA

N77-15773# Syracuse Univ., N.Y.
A GOODNESS OF FIT TEST FOR MULTIVARIATE NORMALITY
G. L. Hensler, K. G. Mehrotra, and J. E. Michalek Griffiss AFB, N. Y. RADC May 1976 15 p refs
(Contract F30602-75-C-0121; AF Proj. 9567)
(AD-A026073; RADC-TR-76-141) Avail: NTIS HC A02/MF A01 CSCL 12/1

A goodness of fit test for multivariate normality is developed. The test procedure reduces the composite null hypothesis to a simple null hypothesis that requires one to test uniformity of a set of observations between 0 and 1. GRA

N77-15774# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
SOME CONTRIBUTIONS TO SUBSET SELECTION PROCEDURES
Wing-Yue Wong May 1976 123 p refs
(Contract N00014-75-C-0455)
(AD-A026019; Mimeo-Ser-454) Avail: NTIS HC A06/MF A01 CSCL 12/1

The main purpose of this paper is to propose and study the subset selection approach for some new problems and make contributions. Chapter 1 deals with some selection and ranking procedures for the largest unknown mean of k normal populations with unequal variances. In chapter 2 some nonparametric subset selection procedures based on U-statistics for selecting the largest of the k location parameters are proposed and studied. Chapter 3 discusses some subset selection procedures for Poisson processes. Chapter 4 deals with a class of selection rules for finite schemes. Chapter 5 discusses some subset selection procedures for a negative multinomial distribution. An inverse sampling rule for selecting the cell with largest cell-probability from a multinomial distribution is considered. GRA

N77-15775# North Carolina Univ., Chapel Hill. Dept. of Statistics.
SOME PROPERTIES AND GENERALIZATIONS OF MULTIVARIATE MORGENSTERN DISTRIBUTIONS
Stamatis Cambanis May 1976 22 p refs
(Grant AF-AFOSR-2796-75)
(AD-A026306; AFOSR-76-0178TR; Mimeo-Ser-1069) Avail: NTIS HC A02/MF A01 CSCL 12/1

The admissible values of the coefficient in a bivariate Morgenstern distribution are found. For multivariate Morgenstern distributions necessary and sufficient conditions are given for its coefficients, and its conditional distributions are found and shown to belong to a family of distributions further extending the multivariate Morgenstern family. Author (GRA)

N77-15776# North Carolina Univ., Chapel Hill. Dept. of Statistics.
ON THE UNIFORMITY OF SEQUENTIAL RANKING PROCEDURES
Raymond J. Carroll May 1976 20 p refs
(Contract N00014-67-A-0014; Grant AF-AFOSR-2796-75; AF Proj. 9769)
(AD-A026305; AFOSR-76-0179TR; Mimeo-Ser-1067) Avail: NTIS HC A02/MF A01 CSCL 12/1

In the class of ranking procedures based on sequential confidence intervals of fixed-length, the probability statements are not uniform in the scale parameter. Further the available generalizations to rankings based on stochastic orderings are not uniform over the parameter space. Two methods are proposed for solving such problems; the first is based on the theory of weak convergence while the second is more direct but only solves the problem when the parameter space is compact. Author (GRA)

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N77-15777# Naval Postgraduate School, Monterey, Calif.
MARKOVIAN QUEUES WITH ARRIVAL DEPENDENCE M.S. Thesis
Jack Burton Gafford Mar. 1976 59 p refs
(AD-A026377) Avail: NTIS HC A04/MF A01 CSCL 12/1

A study of three Markovian queues wherein customers require two separate types of service upon arrival is described. The two service channels operate independently but receive demands through a common arrival process. Transient and steady state results are established in the case that the service channels have an infinite number of servers. The remaining two systems, finite server and finite capacity, are not completely modeled. However, special results concerning their stochastic nature are documented. Author (GRA)

N77-15778# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PERFORMANCE EVALUATION OF THE LINCOLN LABORATORY TIME SHARING SYSTEM
Jay R. Walton 7 May 1976 39 p
(Contract F19628-76-C-0002; AF Proj. 649L)
(AD-A026366; TN-1976-24; ESD-TR-76-106) Avail: NTIS HC A03/MF A01 CSCL 09/2

This paper describes a set of measurements being used to evaluate the performance of the Lincoln Laboratory time sharing computing system. With these measurements it has become possible to make meaningful quantitative statements about the performance of the Laboratory's central computing facility, and to make more rational decisions about where to allocate resources to improve the facility. Author (GRA)

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N77-15779 North Carolina State Univ., Raleigh.
THE STRUCTURE OF PROPER SEMIGROUPS Ph.D. Thesis
Herbert Leonard Shrieves 1976 59 p
Avail: Univ. Microfilms Order No. 76-28516

The structure of proper semigroups is studied and some relationships between compact semigroups and proper semigroups are established. The main result states that each of the Green's relations on a proper semigroup is a proper equivalence. An important consequence of this result is that a noncompact proper semigroup has a non-trivial ideal structure. Quotients of locally compact semigroups are also studied, and a fundamental homomorphism theorem is proved for proper homomorphisms of locally compact semigroups. Finally, the structure of some specific types of proper semi-groups is studied. Characterizations of proper Clifford semigroups, certain proper inverse semigroups and proper semilattices are obtained. A characterization of proper semigroups in terms of their one point compactifications is also proved. Dissert. Abstr.

N77-15780 Michigan Univ., Ann Arbor.
ON QUASISIMILARITY OF OPERATORS ON HILBERT SPACE Ph.D. Thesis
Lawrence Ray Williams 1976 64 p
Avail: Univ. Microfilms Order No. 76-27616

A proof for the theorem that every nilpotent operator on a Hilbert space of arbitrary dimension is quasisimilar to a Jordan operator is simplified and used to establish two additional

theorems. A conjecture is made concerning the uniform closure of the class of all block diagonal nilpotent operators.
Dissert. Abstr.

N77-15781 Rutgers Univ., New Brunswick, N.J.
GENERALIZATION OF THE BANACH CONTRACTION PRINCIPLE AND RELATED RESULTS Ph.D. Thesis
Sandra Lynn Brook 1976 70 p
Avail: Univ. Microfilms Order No. 76-26986

Fixed point theorems for single valued functions in the general setting of a space with sequential structure are studied. Analogous theorems for multivalued functions in a space 'sequence of sets' structure are obtained. Results for single and multivalued functions are in metric and uniform spaces. Generalizations of the Banach contraction principle are considered and results are extended.
Dissert. Abstr.

N77-15782 Yale Univ., New Haven, Conn.
MODEL THEORY OF TOPOLOGICAL STRUCTURES Ph.D. Thesis
Steven Chester Garavaglia 1976 179 p
Avail: Univ. Microfilms Order No. 76-29199

A language M is constructed which is adequate for expressing numerous topological concepts such as openness, closure, density, limit points, and continuity. Many of the results of first-order model theory are extended to M. It is proved that two topological structures satisfy the same sentences in M if and only if they have topologically isomorphic ultrapowers. From this result, topological analogues of the Feferman-Vaught, Craig interpolation, and Robinson consistency theorems are derived. Additional results include preservation theorems, a local version of the ultrapower theorem, and a topological analogue of Sabbagh's theorem on elementary equivalence of modules.
Dissert. Abstr.

N77-15783 Wisconsin Univ., Madison.
A MODEL OF SET THEORY WITH A UNIVERSAL SET Ph.D. Thesis
Emerson Clark Mitchell 1976 38 p
Avail: Univ. Microfilms Order No. 76-20126

Let T be the theory of the language of set theory saying that: (1) Sets are extensional. (2) Every set has a universal complement, i.e., given a set x there is a set y such that every set z is a member of y if and only if it is not a member of x. (3) Every set x has a power set containing exactly the subsets of x. (4) The result of replacing every member of a well founded set by some set is a set. (5) The well founded sets form a model of Zermelo Fraenkel set theory. Then within the universe V of Zermelo Fraenkel set theory there is a definable internal model of T. The members of the internal model are chosen by an inductive definition within V, and then a new membership relation is inductively defined such that the members of the internal model with the defined membership relation satisfy T.
Dissert. Abstr.

N77-15784 Ohio Univ., Athens.
NONLINEAR PROGRAMMING IN NORMED LINEAR SPACES Ph.D. Thesis
Paul Jacob Bender, Jr. 1976 59 p
Avail: Univ. Microfilms Order No. 76-27239

Necessary conditions in the form of multiplier rules were given for a function to have a minimum subject to various combinations of set, equality and inequality constraints. All spaces were taken to be infinite dimensional normed linear spaces, and in some cases completeness was required. Functions to be minimized and constraint defining functions were taken to be differentiable in the sense of Frechet. Due to the nature of the proofs the results were divided into two parts. In the first part results were obtained by finding solutions to adjoint equations. In the second part, proofs were based upon the separation of convex sets by hyperplanes.
Dissert. Abstr.

N77-15785# Wisconsin Univ., Madison. Dept. of Statistics.
A CANONICAL FORM FOR THE PROBLEM OF ESTIMATING SMOOTH SURFACES
Grace Wahba Aug. 1975 18 p refs
(Grant AF-AFOSR-2363-072; AF Proj. 9769)
(AD-A026330; UWIS-DS-75-420; AFOSR-76-0728TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

It is shown how the problem of estimating a smooth surface on a rectangle in Euclidean p-space, which is measured discretely and with normally distributed errors, reduces to the problem of estimating the mean of a multivariate normal vector. Two empirical Bayes type estimates are noted, and it is observed that cross-validation is useful in certain cases.
Author (GRA)

N77-15786# California Univ., Berkeley.
BIHARMONIC GREEN'S FUNCTIONS AND BIHARMONIC DEGENERACY
C. Y. Wang 13 Jan. 1975 10 p refs Repr. from Math. Scandinavica, v. 37, 1975 p 122-128
(Grant DA-ARO(D)-31-124-73-G39)
(AD-A027115; ARO-9653.81-M) Avail: NTIS HC A02/MF A01 CSCL 12/1

It is well known that the harmonic Green's function plays an important role in the harmonic classification theory (e.g. Sario-Nakai (7)). Explicitly, if we denote by O(N) sub HX, X = G,B,D,C, the classes of Riemannian N-manifolds which do not carry harmonic Green's functions, or bounded, Dirichlet finite, or bounded Dirichlet finite, or bounded Dirichlet finite nonconstant harmonic functions, respectively, then we have the strict inclusion relations for every dimension N < or = 2. Recently L. Sario (4) introduced the biharmonic Green's function gamma which, roughly speaking, satisfies gamma = delta gamma = 0 on the ideal boundary of a Riemannian manifold. In the present paper, we shall discuss the role played by gamma in the biharmonic classification theory. It turns out that, in striking contrast with the harmonic case, the class O(N) sub tau of Riemannian N-manifolds which do not carry gamma neither is contained in nor contains any of the classes O(N) sub H(2)X, X = B,D,C, of Riemannian N-manifolds which carry no bounded, Dirichlet finite, or bounded Dirichlet finite nonharmonic biharmonic functions, respectively.
GRA

70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

N77-15787 Maryland Univ., College Park.
THE EFFECT OF GRAVITATIONAL POTENTIAL ON ATOMIC CLOCKS AS OBSERVED WITH A LASER PULSE TIME TRANSFER SYSTEM Ph.D. Thesis
Robert Alan Reisse 1976 230 p
Avail: Univ. Microfilms Order No. 76-28716

The laser beam was directed at the plane where a corner cube was mounted to reflect the pulses back to the ground station. By recording the epoch of the pulse when it was fired at the plane, reflected at the plane, and again detected on the ground after reflection, it was possible to measure the proper time difference between the two clock systems to a resolution of 0.3 ns using up to thirty complete receptions of the light signals. The clocks were isolated from environmental changes by controlling the temperature and pressure of the standards and isolating them from the vibration of the airplane. They were also shielded from the earth's magnetic field. The altitude of the airplane was changed at least twice during a flight; these changes caused smaller rate changes in the flying clocks that could be detected by the laser pulse time transfer system.
Dissert. Abstr.

71 ACOUSTICS

Includes sound generation, transmission and attenuation.

For noise pollution see *45 Environment Pollution*.

N77-15788 Tufts Univ., Medford, Mass.
ACOUSTIC FIELD OF A POINT SOURCE IN A UNIFORM FLOW FOR TWO GEOMETRIES: 1. STATIONARY SOURCE IN A RECTANGULAR DUCT WITH NON-RIGID

WALLS AND 2. MOVING SOURCE IN A FREE FIELD Ph.D. Thesis
John Sarris 1976 120 p
Avail: Univ. Microfilms Order No. 76-27183

A numerical scheme was employed to determine the total acoustic pressure, due to a stationary source, at any location inside a duct with non-rigid walls. The effects of medium convection, wall admittance, and source location were found to be significant for the assigned parameter values. In addition, a series of coordinate transformations were used to derive an expression for the free field acoustic pressure of a moving source in terms of source position at the time of sound emission. Expressions for the Doppler shift in frequency, the acoustic intensity and the acoustic power output of the source in the far field were also derived. Source and medium motion had a significant effect on these quantities. Both parts of this theoretical treatment are relevant to the interpretation of noise measurements in conventional wind tunnels. The results of the first part are applicable for source frequencies in the low-medium range, and the results of the second part are applicable for high source frequencies. Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-15789 Georgetown Univ., Washington, D.C.
A UNIFIED THEORETICAL DESCRIPTION OF ULTRASONIC BEAM REFLECTIONS FROM A SOLID PLATE IN A LIQUID Ph.D. Thesis
Leslie Edwin Pitts 1976 111 p
Avail: Univ. Microfilms Order No. 76-26786

A theoretical analysis is presented of the changes in the beam profile for a Gaussian sound beam, upon reflection from an isotropic solid plate immersed in a liquid medium. It is shown that the reflected sound beam profile can be predicted if the location of the complex zeroes and poles of the infinite plane wave reflection coefficient are known. Further, it is shown that the location of the zeroes and poles of the reflection coefficient is the only information needed for the analysis. The derived expression can be applied to either the case of a single liquid solid interface or to liquid solid-plate liquid interfaces. It is shown that the reflected sound beam profile can be predicted as a function of one parameter which depends upon the location of only one complex zero pole pair. Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-15790*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OPTIMAL ONE-SECTION AND TWO-SECTION CIRCULAR SOUND-ABSORBING DUCT LINERS FOR PLANE-WAVE AND MONOPOLE SOURCES WITHOUT FLOW
Harold C. Lester and Joe W. Posey Washington Dec. 1976 53 p refs
(NASA-TN-D-8348; L-11039) Avail: NTIS HC A04/MF A01 CSCL 20A

A discrete frequency study is made of the influence of source characteristics on the optimal properties of acoustically lined uniform and two section ducts. Two simplified sources, a plane wave and a monopole, are considered in some detail and over a greater frequency range than has been previously studied. Source and termination impedance effects are given limited examination. An example of a turbomachinery source and three associated source variants is also presented. Optimal liner designs based on modal theory approach the Cremer criterion at low frequencies and the geometric acoustics limit at high frequencies. Over an intermediate frequency range, optimal two section liners produced higher transmission losses than did the uniform configurations. Source distribution effects were found to have a significant effect on optimal liner design, but source and termination impedance effects appear to be relatively unimportant. Author

DATA SUMMARY: Optimal properties of a uniform and a two section circular liner for a plane wave and a monopole noise source; variables include conductance, susceptance, transmission loss, insertion loss, source impedance, termination impedance, and normalized frequency; 8 figures and 8 tables include numeric data.

N77-15791*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THEORY OF TWO-POINT CORRELATIONS OF JET NOISE
Herbert S. Ribner Washington Dec. 1976 59 p refs
(NASA-TN-D-8330; L-11058) Avail: NTIS HC A04/MF A01 CSCL 20A

A large body of careful experimental measurements of two-point correlations of far field jet noise was carried out. The model of jet-noise generation is an approximate version of an earlier work of Ribner, based on the foundations of Lighthill. The model incorporates isotropic turbulence superimposed on a specified mean shear flow, with assumed space-time velocity correlations, but with source convection neglected. The particular vehicle is the Proudman format, and the previous work (mean-square pressure) is extended to display the two-point space-time correlations of pressure. The shape of polar plots of correlation is found to derive from two main factors: (1) the noncompactness of the source region, which allows differences in travel times to the two microphones - the dominant effect; (2) the directivities of the constituent quadrupoles - a weak effect. The noncompactness effect causes the directional lobes in a polar plot to have pointed tips (cusps) and to be especially narrow in the plane of the jet axis. In these respects, and in the quantitative shapes of the normalized correlation curves, results of the theory show generally good agreement with Maestrello's experimental measurements. Author

DATA SUMMARY: No numeric data are presented.

N77-15792*# Hersh Acoustical Engineering, Chatsworth, Calif.
SOUND PROPAGATION IN CHOKED DUCTS Final Contractor Report
Alan S. Hersh and C. Y. Liu Dec. 1976 44 p refs
(Contract NAS3-18556)
(NASA-CR-135123) Avail: NTIS HC A03/MF A01 CSCL 20A

The linearized equations describing the propagation of sound in variable area ducts containing flow are shown to be singular when the duct mean flow is sonic. The singularity is removed when previously ignored nonlinear terms are retained. The results of a numerical study, for the case of plane waves propagating in a one-dimensional converging-diverging duct, show that the sound field is adequately described by the linearized equations only when the axial mean flow Mach number at the duct throat M sub th $<$ 0.6. For M sub th $>$ 0.6, the numerical results showed that acoustic energy flux was not conserved. An attempt was made to extend the study to include the nonlinear behavior of the sound field. Meaningful results were not obtained due, primarily, to numerical difficulties. Author

DATA SUMMARY: Results of numerical analyses of sound propagation in ducts; variables include Mach number, sound reflection coefficient, sound transmission; 6 figures include numeric data.

N77-15793# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
MULTILEVEL PISTONPHONE FOR PRODUCING LOW-FREQUENCY SINUSOIDAL PRESSURE FIELDS Final Report, Feb. 1972 - Nov. 1975
Carl G. Toler Mar. 1976 26 p ref
(AF Proj. 7231)
(AD-A026023; AMRL-TR-75-77) Avail: NTIS HC A03/MF A01 CSCL 20/1

This pistonphone is a mechanical device that can generate high-level, low-frequency, sinusoidal pressure fields in small closed volumes over a wide dynamic range for purposes of microphone calibration and laboratory tests. This report describes the device, its performance characteristics, and operational/maintenance procedures. The pistonphone uses two interchangeable pistons (0.39 and 2.05 cm. diameter) and four interchangeable cylindrical chambers (17, 99, 310, 1105 cc.) to produce sound pressures at 8 discrete levels ranging from 109 to 174 dB (re. .00002 newton/sq) over a frequency range of 0.5 to 90 Hz. Tables and graphs present those factors required to compensate for

atmospheric pressure changes, isothermal losses, wavelength effects, nonsinusoidal piston motion, nonlinear compressibility of the gas media, vibration, and microphone equivalent volume. This system provides the capability to measure microphone linearity, frequency response and absolute sensitivity to within + or - 0.2 dB at all levels except 174 dB (or - 0.35 dB) for acoustic pressure fields within the limits indicated. Author (GRA)

DATA SUMMARY: Performance specifications for pistonphone and correction factors for microphone calibration; variables include correction factor (dB), microphone equivalent volume, atmospheric pressure, frequency, vibration spectrum; 5 figures and 1 table include numeric data.

N77-15794# Texas Instruments, Inc., Dallas. Equipment Group.
ADVANCED SIGNAL PROCESSING Final Report, 15 Nov. 1974 - 15 Nov. 1975
William N. Swindell, Mark J. Shensa, and Leo J. Obrien 14 Jan. 1976 76 p refs
(Contract N00014-75-C-0101)
(AD-A026627; TI-ALEX(03)-FR-76-01) Avail: NTIS HC A05/MF A01 CSCL 20/1

This final report discusses the technical results from four independent tasks. The effectiveness of the complex cepstrum technique to resolve multipathed acoustic signals was evaluated and compared to autocorrelation techniques. Significant improvements were made in a curvilinear ray theory propagation model, extending accuracy and improving certain algorithms. The maximum entropy spectrum analysis technique was evaluated in terms of estimation accuracy and parameter behavior. A brief description is given of software developed for the OASIS computer system. GRA

DATA SUMMARY: Results obtained through various techniques for processing acoustic signals; variables include amplitude, time, signal-to-noise ratio, bandwidth, velocity, depth, propagation loss, range, signal power; 24 figures include numeric data.

N77-15795# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science.
ACOUSTIC SCATTERING FROM A WIND DRIVEN WATER SURFACE Final Report, 1 Apr. 1975 - 31 Mar. 1976
Peter N. Schultheiss, Jacqueline Snyder, Henti Tung, and John G. Zornig Jun. 1976 50 p refs
(Contract N00014-75-C-1014)
(AD-A026689; CS-1014-1) Avail: NTIS HC A03/MF A01 CSCL 20/1

A very substantial fraction of the effort was devoted to improving the experimental facility. A partly automated hydrophone positioning system was installed in order to facilitate measurement of scattered power for a variety of transmitter and receiver locations. Improved hydrophone amplifiers now furnish the required signal to noise ratios for reliable measurements with receiver placement varying all the way from the forward-scatter to the back-scatter position. A greatly improved wave-height probe will permit characterization of surface statistics at a level of detail not previously accessible. Such a level of detail appears to be essential to any effort to reconcile experiment with theory. The construction process is now largely complete and measurements are in progress. The first azimuthal surveys of scattered power have been carried out and are included in this report. It is clear from this limited data set that some key features of the scattering process (e.g. back scattered power level) are poorly predicted by existing theory. A major portion of this report is therefore devoted to a review of theoretical background. The standard analytical approaches are examined to see what changes in the usual assumptions might lead to results more compatible with experimental observations. GRA

DATA SUMMARY: Linearity of oscillator period was calibrated in mm vs microseconds; variables are azimuth, decibels, relative height, and relative period; 2 figures include numeric data.

N77-15796# Mississippi Univ., University.
STUDY OF SOUND PROPAGATION IN AIR Final Report, 1 Jul. 1973 - 30 Jun. 1976
Henry E. Bass Jun. 1976 12 p refs
(Contract DAHC04-73-C-0033)
(AD-A026767; ARO-11223.8-E) Avail: NTIS HC A02/MF A01 CSCL 20/1

This report summarizes research on sound absorption performed over a three-year period. This research included measurements of the rotational relaxation time in air at elevated temperatures and measurements of the vibrational relaxation of water vapor during collisions with water vapor, oxygen, nitrogen, and argon. As a result of these measurements the range of temperatures over which these basic physical properties can be accurately predicted over the temperature range normally encountered on the surface of the earth. References to the work published in the open literature is given as well as a brief description of how this work contributed to the development of a new procedure to predict sound absorption in still air. GRA

DATA SUMMARY: No numeric data are presented.

N77-15797# United Technologies Research Center, East Hartford, Conn.
ELECTRONICALLY PROGRAMMABLE PSK SAW DEVICES Quarterly Progress Report, 7 Apr. - 6 Jul. 1975
16 Jul. 1975 20 p refs
(Contract N00014-75-C-0978)
(AD-A026940; UTRC/R75-922116-1; QPR-1) Avail: NTIS HC A02/MF A01 CSCL 20/1

This report describes the work conducted by United Technologies Research Center during the period from 7 April 1975 through 6 July 1975, on a research and development program entitled, 'Electronically Programmable PSK SAW Devices.' Research under this program is directed toward the development of a state-of-the-art Surface Acoustic Wave (SAW) module for use in electronically programmable, long code PSK signal correlation and encoding. The program is based on the UTRC PSK Diode-Correlator, a unique SAW device that utilizes nonlinear mixing phenomena in a hybrid semiconductor delay line configuration. When fully developed in 64 and 128 tap modular form, the PSK Diode-Correlator module will provide advantages in maximum chip rate, minimum tap dissipation, and electronic flexibility. Work during this first quarter has been directed toward: (1) the fabrication of PSK Diode-Correlator components, (2) diagnostic experiments on the amplitude and phase characteristics of PSK taps utilizing silicon-on-sapphire (SOS) diode arrays, and (3) design of 64 and 128 tap Diode-Correlator modulators. This work, which has substantially followed the plan laid out in our program proposal, is detailed. GRA

DATA SUMMARY: Electrical properties of SOS and PSK diode arrays; variables include current-voltage characteristics, forward voltage drop, p-type resistor value, output power, input power, bias current; 4 figures include numeric data.

N77-15798# SACLANT ASW Research Center, La Spezia (Italy).
A MODEL FOR THE DOPPLER SPREAD OF BACKSCATTERED SOUND FROM A COMPOSITE ROUGHNESS SEA SURFACE
Herward Schwarze 1 May 1976 100 p refs Sponsored by NATO
(AD-A026949; SACLANTCEN-SM-86) Avail: NTIS HC A05/MF A01 CSCL 20/1

A theoretical model for the Doppler spread of backscattered acoustic waves from the rough sea surface is described on the basis of a two component structure (facet model) of the sea surface. The facet statistics are derived for a general gaussian sea surface. The results are evaluated for a Pierson-Moskowitz spectrum. A procedure for choosing the facet length is developed. Approximate, simple formulae for the Pierson-Moskowitz case are given. The general result for the Doppler spread of the backscattered acoustic wave is evaluated for a sea surface spectrum due to Scott and examples for Doppler spectra are given for different windspeeds, wind directions, grazing angles and acoustic frequencies. GRA

DATA SUMMARY: Both normalized and nonnormalized Doppler shifts are compared to Doppler spectral density; variables include facet slope, vertical facet velocity, horizontal facet velocity, correlation slope-vertical velocity, correlation coefficient, roughness

on the facet, relative facet length, Doppler spectrum, Doppler shift, and normalized Doppler shift; 28 figures include numeric data.

N77-15799# Naval Underwater Systems Center, New London, Conn.
A SYNOPSIS OF STUDIES ON THE INTERACTION OF LOW FREQUENCY ACOUSTIC SIGNALS WITH THE OCEAN BOTTOM
Salvatore R. Santaniello, Frederick R. DiNapoli, Robert K. Dullea, and Peter D. Herstein 30 Jun. 1976 45 p refs
(NUSC Proj. A-650-06; SF52552601)
(AD-A027657; NUSC-TD-5337) Avail: NTIS HC A03/MF A01 CSCL 20/1

Understanding the mechanisms by which the ocean sediment redirects impinging sound back into the ocean is necessary in developing propagation models for SONAR performance prediction. Thus, NUSC has (1) conducted controlled, self-calibrating acoustic measurements where the bottom interacted signal is isolated in time for analysis, (2) developed deconvolution processing techniques to aid in describing the impulse response of the ocean sediment and (3) performed modeling to study the interaction of acoustic waves at the ocean bottom. This document presents a synopsis of the studies primarily showing the necessity to consider the refraction of sound by the ocean sediment when predicting low frequency propagation loss. Sediment refraction of sound and reflection of sound by the sediment interface and subbottom layering are the causes for the negative bottom loss phenomenon and for a given frequency bandwidth dependence and receiver depth dependence of bottom loss. Deconvolution analyses have aided in time resolution of intrapulse signals that make up the bottom interacting arrivals. Resolution of these arrivals aids in interpreting results. The FFP modeling effort provides quantitative evidence for the necessity to consider the refraction of sound by the ocean sediment to properly interpret low frequency propagation loss measurements in areas where the ocean bottom plays an important part. Author (GRA)

DATA SUMMARY: Results of underwater acoustics investigations; variables include reflection coefficient,grazing angle, amplitude, time, frequency, range, depth, relative pressure, losses; 15 figures include numeric data.

N77-15800# Pennsylvania State Univ., University Park. Applied Research Lab.
ACOUSTIC RADIATION FIELDS OF AXISYMMETRIC SPHERICAL SOURCES WITH MIXED BOUNDARY CONDITIONS M.S. Thesis
Christopher C. Gerding 11 Mar. 1976 83 p refs
(Contract N00017-73-C-1418)
(AD-A027522; TM-76-76) Avail: NTIS HC A05/MF A01 CSCL 20/1

Three acoustic radiation problems concerning axisymmetric radiating spheres with mixed boundary conditions on their surfaces have been treated numerically. They are: first, a radially vibrating polar cap mounted on an otherwise rigid spherical baffle; second, the same cap mounted on an otherwise pressure release spherical baffle; and third, the same cap and a contiguous pressure release belt, both mounted on an otherwise rigid spherical baffle. The solution of the first problem is obtainable in terms of eigenfunctions, which are orthogonal over the sphere, and is consequently well known; it was thus used as a comparison check for the second and third problem. The solutions of the above problems were accomplished by assuming a Fourier-Legendre series expansion of the acoustic pressure field and numerically determining the coefficients in the expansion, either by the least mean square error method, or by boundary collocation. The first and second problems were solved by both methods, while the third was treated by the least mean square error method only. The numerical computations were performed on an IBM 370/168 digital computer in FORTRAN IV. GRA

DATA SUMMARY: Normalized characteristics for rigid and pressure release baffles; variables include normalized radiation impedances, normalized surface velocity, normalized surface pressure, angle theta; 10 figures include numeric data.

N77-15801# Pennsylvania State Univ., University Park. Dept. of Architectural Engineering.
SOUND POWER MEASUREMENTS IN REVERBERATION CHAMBERS Final Report, Jun. 1973 - Jan. 1976
Jiri Tichy, Martin J. Brien, and Kenneth P. Roy Jan. 1976 234 p refs
(Contract NBS-4-9030)
(PB-256639/6; NBS-GLR-76-59) Avail: NTIS HC A11/MF A01 CSCL 20A

Analytic and experimental studies of the effect of moving diffusers on the precision and accuracy of reverberation room measurements are reported. The analytic model involves numerical computations of the sound field produced by a point source in a rectangular room with one moving wall. The results of computations suggest that a moving diffuser reduces spatial variation of sound fields from pure tone sources, improving the precision of the measurement, but do not necessarily improve the measurement accuracy. The effectiveness of the diffuser is found to depend on room absorption, source position and frequency, in the low frequency band studied. GRA

DATA SUMMARY: Diverse data are presented; variables include noise source points, normalized variance for source frequencies, oscillating wall frequency, amplitude of the oscillating wall, absorption coefficient, standard deviation of the distribution of SPL, reverberation time, coefficient of diffuser efficiency, sound power.

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

N77-15802 Minnesota Univ., Minneapolis.
ELECTRONIC AND MOLECULAR TRANSPORT IN FLUIDS Ph.D. Thesis
Roger Gates Brown 1976 138 p
Avail: Univ. Microfilms Order No. 76-27876

The motion of excess electrons in liquid argon is considered using the kinetic equation approach of Cohen and Lekner. Their solution of the Boltzmann Equation gives both a qualitative and quantitative description of the mobility of an excess electron in liquid argon at high densities, but fails to describe the zero field mobility maximum as a function of density. This is shown to be due to their incorrect handling of the long range electron-atom interaction potential. An interaction potential is proposed that contains the features expected of a reasonable electron-atom interaction and which also describes the mobility maximum as a function of density. The extension of Cohen and Lekner's theory to molecules having internal modes is presented. It is shown that the more rapidly the scattering length autocorrelation function decays the larger the fractional energy loss per collision, therefore explaining why the mobilities of electrons in most hydrocarbons are constant up to very high fields. Dissert. Abstr.

N77-15803 Southern Illinois Univ., Carbondale.
A SECOND-ORDER PERTURBATION STUDY OF ONE-ELECTRON DIATOMIC MOLECULES Ph.D. Thesis
Ahmad A. Mahbotchi 1976 72 p
Avail: Univ. Microfilms Order NO. 76-26950

The hydrogenic and the Guillemin and Zener functions are used as zero order wave functions to obtain second order wave functions and fourth and fifth order perturbation energy coefficients. The first and second order energy coefficients are derived from the boundary conditions on the wave function. The possibility of obtaining similar closed form expressions for the higher order energy coefficients is discussed. Dissert. Abstr.

N77-15804 Missouri Univ., Rolla.
ELECTRON-HYDROGEN ATOMS SCATTERING IN THE PRESENCE OF AN ELECTROMAGNETIC FIELD Ph.D. Thesis
John Thomas Reed, III 1976 129 p
Avail: Univ. Microfilms Order No. 76-26867

Calculations are presented for cross sections for elastic and

inelastic electron-hydrogen atom scattering when the scattering takes place in an electromagnetic field. Born approximation for single photon absorption is used. The wave functions are found by solving a second order inhomogeneous differential equation by Laplace transform, Green's function, and numerical integration. These wave functions are integrated numerically to obtain the total cross section. The cross section is calculated explicitly for photon energies of 0.05, 0.1, 0.2, 0.3, and 0.374 atomic units as a function of the incident electron momentum, and as a function of the photon energy at an incident momentum of 5.0 atomic units. Polarization effects of the incident radiation are discussed, and approximations for these cross sections are considered. Dissert. Abstr.

N77-15805 State Univ. of New York, Stony Brook.
GAUGE FIELD MODELS OF WEAK INTERACTIONS Ph.D. Thesis
Desmond-Joseph Darby 1976 107 p
Avail: Univ. Microfilms Order No. 76-28056

The calculation is done in a general gauge and simple Slavnov-Taylor identities are exploited to eliminate all gauge dependence before any loop integration is performed. The model presented here shares many of the theoretical inadequacies of the Weinberg-Salam model, and as an independent investigation, a recent suggestion for dealing with some of these problems, which involves the incorporation of Majorana fields, is discussed. The restrictions on building gauge models with Majorana fields are studied, and an example is given. Dissert. Abstr.

N77-15806 California Univ., Davis.
RAMAN SPECTROSCOPIC STUDIES OF ISOTOPIC DIATOMIC MOLECULES AND A TECHNIQUE FOR MEASURING STABLE ISOTOPE RATIOS USING RAMAN SCATTERING Ph.D. Thesis
Robert Charles Harvey 1976 81 p
Avail: Univ. Microfilms Order No. 76-28975

A method for measuring stable isotope ratios using Raman scattering was developed which consists of simultaneously counting photons scattered out of a high-intensity laser beam by different isotopically-substituted molecules. As a result of the Raman isotope effect, isolation of photons from different isotopic species is readily accomplished by using monochromators. Extrapolation of measured count rates to those obtainable by improving laser and monochromator systems indicates that highly-accurate isotope ratio measurements (< or = 0.1% precision) can be made using Raman scattering in less than one-tenth the time required for the same measurement using conventional mass spectrometry. A Raman spectrometer was assembled which can obtain much higher resolution (approximately 0.1/cm) than a conventional spectrometer and allows work with signal levels heretofore impractical (< 0.1 counts/sec). Using this spectrometer a number of studies of isotopic diatomic molecules were made. Dissert. Abstr.

N77-15807 Southern Illinois Univ., Carbondale.
A MULTIPERTURBATION STUDY OF THE GROUND STATE OF THREE-ELECTRON ATOMS Ph.D. Thesis
Yat Yan Yung 1976 37 p
Avail: Univ. Microfilms Order No. 76-28787

The theory used in this study automatically decouples Rayleigh-Schrodinger perturbation theory into multiperturbation partial differential equations for the 2-through (n+1)-electron components of the nth-order wave funtion. Thus the first-order wave function of a three-electron atom can be constructed from first-order, two-electron wave functions while the second-order wave function contains second-order, two-electron wave functions and some additional three-electron wave functions. Second- and third-order energy coefficients were computed based on this first-order wave function and compared to previous results. The three-electron component was also obtained for the second-order wave function, and the fourth-order energy coefficient was computed. Finally the energies for the lithium isoelectronic sequence were computed from the energy expansion through fourth order. Dissert. Abstr.

N77-15808 Yale Univ., New Haven, Conn.
DESIGN AND CONSTRUCTION OF A MOLECULAR BEAM MACHINE TO STUDY THE KINETICS OF BIMOLECULAR REACTIONS Ph.D. Thesis
Katherine Marie Turner Alben 1976 251 p
Avail: Univ. Microfilms Order No. 76-28845

In the detector, neutral molecules are ionized and mass filtered. The pulse height of the ion beam is amplified by accelerating the ions onto a high voltage target, which ejects secondary electrons; the electrons strike a plastic scintillator which emits photons that are collected by a photomultiplier. Gates to the detector for counting the signal from the photomultiplier are synchronized with the chopping of the sources, in order to resolve the signal from the background. Thus far the limit to the machine's performance has been the low ionization and extraction efficiency of the detector. Dissert. Abstr.

N77-15809*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMMENT ON THE RELATION BETWEEN THE NONADIABATIC COUPLING AND THE COMPLEX INTERSECTION OF POTENTIAL ENERGY CURVES
Richard L. Jaffe Jan. 1977 20 p refs
(NASA-TM-X-73196; A-6705) Avail: NTIS HC A02/MF A01 CSCL 20H

Simple relations are discussed that provide a correspondence between the complex intersection of two potential surfaces and the nonadiabatic coupling matrix element between those surfaces. These are key quantities in semiclassical and quantum mechanical theories of collision induced electronic transitions. Within the two state approximation, the complex intersection is shown to be directly related to the location and magnitude of the peak in the nonadiabatic coupling. Two cases are considered: the avoided crossing between two potential surfaces; and the spin orbit interaction due to a P-2 halogen atom. Comparisons are made between the results of the two-state model and the results of ab initio quantum chemical calculations. Author

N77-15810*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANGULAR DISTRIBUTION OF AUGER ELECTRONS DUE TO 3d-SHELL IONIZATION OF KRYPTON
Kazem Omidvar Jan. 1977 16 p refs Submitted for publication
(NASA-TM-X-71259; X-602-77-1) Avail: NTIS HC A02/MF A01 CSCL 20H

Cross sections for electron impact ionization of krypton due to ejection of a 3rd shell electron have been calculated using screened hydrogenic and Hartree-Slater wave functions for target atom. While the total ionization cross sections in the two approximations are within 10% of each other, the Auger electron angular distribution, related to cross sections for specific magnetic quantum numbers of the 3rd electrons, is widely different in the two approximations. The angular distribution due to Hartree-Slater approximation is in excellent agreement with measurement. The physical reason for the discrepancies in the two approximations is explained. Author

N77-15811# National Bureau of Standards, Washington, D.C.
TRANSITION PROBABILITIES FOR IONIZED ATOMS Final Report
A. W. Weiss 1976 20 p refs Repr. from Beam-Foil Spectry., v. 1, 1976 p 51-68 Presented at 4th Intern. Conf. on Beam-Foil Spectry., Gatlinburg, Tenn., 15-19 Sep. 1976 Submitted for publication Sponsored by ERDA
(PB-257109/9) Avail: NTIS HC A02/MF A01 CSCL 07D

Several aspects of the line strength problem for ionized atomic systems are discussed. Level crossings, which arise from the restructuring of the ionic spectrum, occur frequently in the medium stages of ionization and can produce severe irregularities in the f-value behavior along an isoelectronic sequence. Calculations on several such examples are described. For very highly ionized species relativistic effects must be taken into account, and the hydrogen like line strengths are discussed as a prototype of orbital relativistic effects. GRA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation*.

N77-15812 Michigan Univ., Ann Arbor.
THE APPLICATION OF THE FINITE ELEMENT METHOD TO THE NEUTRON TRANSPORT EQUATION Ph.D. Thesis
William Russell Martin 1976 230 p
Avail: Univ. Microfilms Order No. 76-27539

The equivalent integral law (or weak form) of the first order neutron transport equation was derived. Application of the finite element method (Galerkin approach) resulted in a system of algebraic equations. A computer code capable of solving the neutron transport equation in a 1-D plane geometry was developed. Vacuum, reflecting, or specified incoming boundary conditions may be analyzed. The time dependent transport equation was also examined. Numerical results are given for several critical slab eigenvalue problems, including anisotropic scattering. Precise numerical tests were made on the convergence rate of the approximate solution with mesh refinement and also with the eigenvalue error. Finally, time dependent problems were examined, and it was shown that the angular mesh has a dominant effect on obtaining acceptable solutions to the time dependent transport equation. Dissert. Abstr.

N77-15813 Polytechnic Inst. of New York.
A NON-DESTRUCTIVE BUNCH LENGTH MONITOR FOR A PROTON LINEAR ACCELERATOR Ph.D. Thesis
Richard Lloyd Witkover 1976 112 p
Avail: Univ. Microfilms Order No. 76-23456

A method is presented for obtaining longitudinal density distribution measurements in a nondestructive manner which allows direct display on a low frequency X-Y recorder or oscilloscope. The potential bandwidth is tens of gigahertz. The technique is based upon the coherent transferral of the density information from the protons in the bunch to secondary emission electrons emitted from a foil in the beam's path. These electrons are than energy modulated by the RF used to accelerate the protons, and analyzed with a magnetic spectrometer. This converts the energy variation with time to a positional variation with time which can be observed with low frequency electronics. A probe of this type was built to evaluate the feasibility of this technique. Measurements with the device indicated an equivalent bandwidth of over 10GHz. Dissert. Abstr.

N77-15814 British Library Lending Div., Boston Spa (England).
THE CHOICE AND OPTIMIZATION OF A MODERATOR FOR A PULSED SLOW-NEUTRON SOURCE
S. N. Ishmaev, I. P. Sadikov, and A. A. Chernyshov 8 Apr. 1976 26 p refs Transl. into ENGLISH from Russian report IAE-2019
(BLL-Trans-75-129-(8053.465); IAE-2018) Avail: British Library Lending Div., Boston Spa, Engl.:

The results are presented of the experimental investigations carried out with the object of optimizing hydrogenous moderators. The time dependence of the neutron flux for different energies and for various moderator compositions based on polyethylene and water was measured by means of a crystal spectrometer on the linear accelerator. The effect of the geometry, the thickness and the temperature of the moderator, the addition of absorbers and use of reflector-filters on the intensity and pulse width of monoenergetic neutrons was studied. Author

N77-15815 Yale Univ., New Haven, Conn.
HEAVY-ION TRANSFER REACTIONS OF ARGON BEAMS ON DEFORMED AND SPHERICAL TARGETS Ph.D. Thesis
Richard Carl Eggers 1976 166 p
Avail: Univ. Microfilms Order No. 76-29195

With a simple classical argument, it is predicted that the effect of nuclear deformation will be a more gradual rise in the excitation functions for heavy-ion reactions. Dissert. Abstr.

N77-15816# Wisconsin Univ., Madison. Dept. of Mechanical Engineering and Statistics.
FEASIBILITY STUDY OF ON-LINE SAFETY EVALUATION AND MONITORING OF MALFUNCTIONS OF THE NUCLEAR REACTOR SYSTEM BY DYNAMIC DATA SYSTEM Final Report
S. M. Wu Aug. 1976 156 p refs Sponsored by Elec. Power Res. Inst.
(PB-257532/2; EPRI-NP-189) Avail: NTIS HC A08/MF A01 CSCL 18I

An advanced time series analysis methodology is reported for use in reactor core barrel dynamics problems. Auto-regressive moving average time series modeling is used. To demonstrate the viability of this data dependent approach, neutron noise data from two nuclear units were analyzed. The report claims these analyses duplicated classical statistical results, but without complications of variance or bias. The superiority of the time series method in procuring parameter estimates in a data efficient manner is also discussed. GRA

N77-15817# Austin Research Associates, Inc., Tex.
A THEORETICAL INVESTIGATION OF THE PRINCIPLE OF AUTO-RESONANT ACCELERATION. PART 2: APPENDIXES O-Z Final Report
W. E. Drummond, G. I. Bourianoff, E. P. Cornet, D. E. Hasti, W. W. Rienstra, M. L. Sloan, H. V. Wong, J. R. Thompson, and J. R. Uglum Jun. 1976 221 p
(Contract F29601-75-C-0029; AF Proj. 2872)
(AD-A027127; ARA-205-Pt-2-App; I-ARA-75-U-155-Pt-2-App; AFWL-TR-75-296-Pt-2-App) Avail: NTIS HC A10/MF A01 CSCL 20/8

A detailed examination of the principle of Auto-Resonant acceleration has been undertaken. This investigation, including both theoretical and computational analysis, has delineated the requirements and limitations on electron beam parameters, magnetic field configurations, ion current, and wave growth mechanisms which must be met for proper functioning of an Auto-Resonant Accelerator. Author (GRA)

N77-15818# Austin Research Associates, Inc., Tex.
A THEORETICAL INVESTIGATION OF THE PRINCIPLE OF AUTO-RESONANT ACCELERATION. PART 1: REPORT SUMMARY AND APPENDIXES A-N Final Report
W. E. Drummond, G. I. Bourianoff, E. P. Cornet, D. E. Hasti, W. W. Reinstra, M. L. Sloan, H. V. Wong, J. R. Thompson, and J. R. Uglum Kirtland AFB, N. Mex. AFWL Jun. 1976 214 p Sponsored in part by DARPA
(Contract F29601-75-C-0029; AF Proj. 2872)
(AD-A027126; ARA-205-Pt-1-App; I-ARA-75-U-155-Pt-1; AFWL-TR-75-296-Pt-1) Avail: NTIS HC A10/MF A01 CSCL 20/8

A detailed examination of the principle of Auto-Resonant acceleration has been undertaken. This investigation, including both theoretical and computational analysis, has delineated the requirements and limitations on electron beam parameters, magnetic field configurations, ion current, and wave growth mechanisms which must be met for proper functioning of an Auto-Resonant Accelerator. Author (GRA)

N77-15819# Science Applications, Inc., Palo Alto, Calif.
ATWS; A REAPPRAISAL. PART 1: AN EXAMINATION AND ANALYSIS OF WASH-1270, TECHNICAL REPORT ON ATWS FOR WATER-COOLED POWER REACTORS
R. R. Fullwood, R. C. Erdmann, A. A. Garcia, F. L. Leverenz, Jr., and E. T. Rumble Aug. 1976 68 p Sponsored by EPRI
(PB-257663/5; EPRI/NP-251-Pt-1) Avail: NTIS HC A04/MF A01 CSCL 18I

The project's goals include estimates of: the actual probability of failure to scram; the probabilities of initiating events. And the risk of the numerical information is upgraded by correcting deficiencies in the document and updating the input data. GRA

N77-15820# Science Applications, Inc., Palo Alto, Calif.
ATWS; A REAPPRAISAL. PART 2: EVALUATION OF SOCIETAL RISKS DUE TO REACTOR PROTECTION SYSTEM FAILURE. VOLUME 1: BWR RISK ANALYSIS
R. C. Erdmann, A. A. Garcia, J. E. Kelly, F. L. Leverenz, Jr., and E. T. Rumble Aug. 1976 50 p refs Sponsored by EPRI
(PB-257664/3; EPRI/NP-265-Pt-2-Vol-1) Avail: NTIS HC A03/MF A01 CSCL 18I

This volume examines and documents the potential contribution to societal risks. GRA

N77-15821# Science Applications, Inc., Palo Alto, Calif.
ATWS; A REAPPRAISAL. PART 2: EVALUATION OF SOCIETAL RISKS DUE TO REACTOR PROTECTION SYSTEM FAILURE. VOLUME 2: BWR FAULT TREE EVALUATION
R. C. Erdmann, A. A. Garcia, F. L. Leverenz, Jr., and E. T. Rumble Aug. 1976 100 p refs Sponsored by EPRI
(PB-257665/0; EPRI/NP-265-Pt-2-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 18I

A detailed description of the re-evaluation and expansion of the fault tree is presented. Details of the reactor protection system evaluation to assure perception are examined. The new results for rps unavailability show that the median value is now approximately a factor of six and the mean value an order of magnitude smaller. GRA

74 OPTICS

Includes light phenomena.

N77-15822 Arizona Univ., Tucson.
TILTED COMPONENT OPTICAL SYSTEMS Ph.D. Thesis
Richard Alfred Buchroeder 1976 188 p
Avail: Univ. Microfilms Order No. 76-28201

The Gaussian, first and third order properties of a type of unsymmetrical optical system called Tilted Component Optical Systems are described. It is shown that the Gaussian properties of the completely unsymmetrical system differ very little from those of familiar rotationally symmetrical systems. The main difference is that the imagery is typically anamorphic. In the two principal meridians, which are always orthogonal, the usual rules for symmetric systems can be applied. Various approaches that an optical designer might take to create tilted component optical systems, both analytically and empirically, are discussed and illustrated with examples. Some of these exhibit wide-field optical correction. Computer ray-tracing shows that the results are in good agreement with first and third order prediction even though the designs are considerably beyond the realm where low order prediction is considered reliable. Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-15823 Arizona Univ., Tucson.
THE THEORY OF IMAGE SAMPLING AND MULTIPLEXING USING PHASE GRATINGS Ph.D. Thesis
Theodore Edward Shrode 1976 89 p
Avail: Univ. Microfilms Order No. 76-28217

A method for spatially modulating the primary image formed by an incoherent imaging system with a periodic phase element so that the secondary image, as formed by a relay system, is intensity modulated at the same frequency as the phase element is described. The high frequency obtainable in the intensity modulation function and the localization of the modulated image allows the method to be used for sampling the primary image at or near the diffraction limit of the primary imaging system. By means of position image multiplexing the primary image can be sampled at the Nyquist interval, thereby avoiding problems of aliasing. It is shown that the image modulation profile is nearly achromatic when used with a broadband source. Also, the method increases the modulated image irradiance by concentrating the radiant energy into smaller areas. A typical application of this property is the use of a solid state detector array to sample the modulated image. Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-15824 Michigan Univ., Ann Arbor.
OPTICAL PROPAGATION IN HOLOGRAPHIC GRATINGS Ph.D. Thesis
Rodney Clifford Alferness 1976 179 p
Avail: Univ. Microfilms Order No. 76-27432

A physical approach for analyzing optical propagation in periodic structures of arbitrary thickness is developed. Known as the method of thin-grating decomposition, it is based upon the concepts used in coherent optics to treat propagation in discrete systems. Using this approach, higher-order readout of thick gratings, propagation in strongly-coupled multiple gratings, and the angular selectivity apodization that results from a nonuniform index modulation profile are examined. A general three-wave analysis is performed to derive algebraic expressions for the efficiency of the diffracted orders for the first two topics. Experimental results from gratings recorded in dichromated gelatin film are in good agreement with the theory. Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-15825 Georgetown Univ., Washington, D.C.
THE TANDEM WADSWORTH MOUNT: THEORY AND APPLICATION OF A NEW HIGH RESOLUTION SPECTROGRAPH Ph.D. Thesis
John-David Francis Bartoe 1976 190 p
Avail: Univ. Microfilms Order No. 76-26788

Two classical concave gratings are arranged in tandem to create a double-dispersion spectrograph having very high spectral and spatial resolution. The first grating is used in the Wadsworth arrangement and acts as a collimator. The second grating is placed so that it acts as a Wadsworth camera, in which the light bundle of a certain wavelength illuminating a particular section of the second grating is diffracted along the local normal of that section. This results in almost aberration-free imaging over a wide wavelength range. Residual aberrations present in the tandem Wadsworth mount are derived both analytically and by use of a computer ray-tracing program. The focal plane shape and position are calculated for several f numbers, diffraction angles, and wavelengths. A tandem Wadsworth mount spectrograph was constructed for use in a rocket-borne instrument designed to observe the sun in the vacuum ultraviolet. Details of the spectrograph design are described, along with a comparison of its theoretical and experimental performance. Some results of the solar observations are also presented. Dissert. Abstr.

DATA SUMMARY: Data Summary not prepared due to nonavailability of complete document for processing.

N77-15826*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
FIBER OPTIC MULTIPLEX OPTICAL TRANSMISSION SYSTEM Patent Application
Charles H. Bell, inventor (to NASA) Filed 18 Aug. 1976 20 p
(NASA-Case-KSC-11047-1; US-Patent-Appl-SN-715485) Avail: NTIS HC A02/MF A01 CSCL 20F

A multiplex optical transmission system for simultaneously transmitting and receiving a number of signals while minimizing external interference is described. The system includes several subgroup mixers which block video signals, digital data signals, and audio signals into respective frequency ranges. The output of the subgroup mixers are fed to a master mixer that produces a composite electrical signal. An optical transmitter is connected to the master mixer for converting the composite signal into an optical signal and transmitting the optical signal over a fiber optic cable. An optical receiver is connected to the other end of the fiber optic cable for receiving the optical signal and converting it back into a composite electrical signal. A demultiplexer is coupled to the output of the optical receiver for separating the composite signal back into video, data, and audio signals. A programmable optical patch board selectively connects the optical signals to various receivers and transmitters. NASA

DATA SUMMARY: Multiplex frequency spectrum; variables include frequency (MHz); 1 figure includes numeric data.

N77-15827*# Perkin-Elmer Corp., Norwalk, Conn. Optical Technology Div.
SPACE TELESCOPE PHASE B DEFINITION STUDY. VOLUME 2A: SCIENCE INSTRUMENTS, ASTROMETER Final Report
A. B. Wissinger and D. J. McCarthy May 1976 173 p
(Contract NAS8-29948)

(NASA-CR-150142; ER-320A-Vol-2A) Avail: NTIS HC A08/MF A01 CSCL 20F

The analysis and design of an astrometer instrument for the space telescope are discussed. The design concepts utilize the astrometric multiplexing area scanner and the OTA fine guidance sensor. Author

DATA SUMMARY: Diverse data are presented; variables include length, weight, power, wavelength.

N77-15828*# Perkin-Elmer Corp., Norwalk, Conn. Optical Technology Div.
SPACE TELESCOPE PHASE B DEFINITION STUDY. VOLUME 2A: SCIENCE INSTRUMENTS, f24 FIELD CAMERA Final Report
R. P. Grosso and D. J. McCarthy Apr. 1976 150 p ref
(Contract NAS8-29948)
(NASA-CR-150143; ER-321-Vol-2A) Avail: NTIS HC A07/MF A01 CSCL 20F

The analysis and design of the F/24 field camera for the space telescope are discussed. The camera was designed for application to the radial bay of the optical telescope assembly and has an on axis field of view of 3 arc-minutes by 3 arc-minutes. Author

DATA SUMMARY: Diverse data are presented; variables include length, weight, power, wavelength.

N77-15829*# Perkin-Elmer Corp., Norwalk, Conn. Optical Technology Div.
SPACE TELESCOPE PHASE B DEFINITION STUDY. VOLUME 2A: SCIENCE INSTRUMENTS, f48/96 PLANETARY CAMERA Final Report
R. P. Grosso and D. J. McCarthy Apr. 1976 129 p
(Contract NAS8-29948)
(NASA-CR-150144; ER-322-Vol-2A) Avail: NTIS HC A07/MF A01 CSCL 20F

The analysis and preliminary design of the f48/96 planetary camera for the space telescope are discussed. The camera design is for application to the axial module position of the optical telescope assembly.

DATA SUMMARY: Diverse data are presented; variables include length, resolution, accuracy, weight, power, wavelength.

N77-15830*# Perkin-Elmer Corp., Norwalk, Conn. Optical Technology Div.
SPACE TELESCOPE PHASE B DEFINITION STUDY. VOLUME 2A: SCIENCE INSTRUMENTS, HIGH SPEED POINT/AREA PHOTOMETER Final Report
May 1976 108 p Prepared in cooperation with Ball Bros. Res. Corp., Boulder, Colo.
(Contract NAS8-29948)
(NASA-CR-150145; ER-330-Vol-2A; F76-08-Vol-2A) Avail: NTIS HC A06/MF A01 CSCL 20F

The analysis and preliminary design of a high speed point/area photometer for the space telescope are summarized. The scientific objectives, photometer requirements, and design concepts are presented. F.O.S.

DATA SUMMARY: Extending spatial and temporal resolution beyond constraints of atmospheric scintillation; variables include wavelength, detection, transmission efficiency, relative intensity, and obscuration ratio; 4 figures, and 1 table include numeric data.

N77-15831# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
TARGET ENHANCEMENT BY FOURIER OPTICAL PROCESSING M.S. Thesis
Dennis T. Tharp Jun. 1976 82 p refs
(AD-A026009; GEO/PH/76-1) Avail: NTIS HC A05/MF A01 CSCL 09/2

Techniques for optical processing with binary spatial filters are well known. A target enhancement system was constructed using a Fourier Transform Optical Processing System. The objective of this system was to enhance the edges of man-made targets that were located within an object field. Color illustrations reproduced in black and white. GRA

DATA SUMMARY: No numeric data are presented.

N77-15832# Washington Univ., Seattle. Dept. of Electrical Engineering.
OPTICAL COUPLING TECHNIQUES Final Report, 1 Mar. 1973 - 29 Feb. 1976
Gordon L. Mitchell, William D. Scott, and R. B. Smith 1 Apr. 1976 56 p refs
(Contract N00123-73-C-1200)
(AD-A026126) Avail: NTIS HC A04/MF A01 CSCL 17/2

Single mode fiber optic systems are crucial to the development of high bandwidth military communications. The crucial problem which remains to be solved is coupling between system components. The research detailed in this report has produced two new methods of coupling between semiconductor lasers, diffused modulators, and single mode fibers. For applications which can use butt joining techniques, a transition structure which matches the geometries involved has been used. This transition is particularly effective in laser-fiber or laser modulator coupling situations. By properly choosing transition materials and physical dimensions we expect to increase laser coupling efficiency to at least 50%. It is now approximately 5-10%. GRA

DATA SUMMARY: Results of mathematical prediction and experimental investigations of the behavior of optical coupling devices; variables include coupling efficiency, coupling coefficient, coupled light, guide separation, guide thickness, output intensity, fiber length, guided mode width; 8 figures and 1 table include numeric data.

N77-15833# Intelcom Rad Tech, San Diego, Calif.
ANALYSIS OF THE PERFORMANCE OF INFRARED DETECTORS UNDER RADIATION ENVIRONMENT Final Report, Jul. 1974 - Jul. 1975
Roland E. Leadon and Barry A. Green Hanscom AFB, Mass. AFCRL 26 Jun. 1975 54 p refs
(Contract F19628-72-C-0349; DNA Proj. NWED-QAXTA026) (AD-A027590; INTEL-RT-8028-010; AFCRL-TR-75-0363) Avail: NTIS HC A04/MF A01 CSCL 17/5

A computer model for low-temperature silicon detectors has been used to show that blocking contacts have little effect on the response of detectors to pulses of radiation when the recombination lifetime is short compared to the transit time for the device. The same computer model has been used to demonstrate that spontaneous spiking noise in silicon detectors at large biases is apparently the result of avalanche generation of carriers in high-field regions near the device contacts. For HgCdTe detectors, the variation of detector response after a change in background illumination has been shown to be the result of a competition between Shockley-Read and Auger recombination in the bulk of the device. GRA

DATA SUMMARY: Response time histories and spontaneous spiking noise observed at large biases in low temperature silicon detectors; variables include initial response time, recovery time, background illumination, circuit load resistance, detector response, % signal recovery, spike amplitude, trap density, carrier density, acceptor density; 14 figures and 2 tables include numeric data.

N77-15834# National Bureau of Standards, Washington, D.C.
OPTICAL MATERIALS CHARACTERIZATION Semiannual Technical Report, 1 Feb. - 31 Jul. 1976
Albert Feldman, Deane Horowitz, Roy M. Waxler, and Marilyn J. Dodge Aug. 1976 21 p refs
(ARPA Order 2620)
(PB-257196/6; NBSIR-76-1115) Avail: NTIS HC A02/MF A01 CSCL 20F

Windows subjected to high-average-power laser radiation will undergo optical and mechanical distortion due to absorptive heating. If the distortion becomes sufficiently severe, the windows become unusable. Theoretical calculations of optical distortion in laser windows depend on the following material parameters: absorption coefficient, refractive index, change of index with temperature, thermal expansion coefficient, stress-optical constants, elastic compliances, specific heat, thermal conductivity,

and density. This program was established to measure refractive indices, changes of index with temperature, stress-optical constants, elastic compliances, and thermal expansion coefficients of candidate laser window materials such as CaF2, BaF2, and ZnSe. GRA

DATA SUMMARY: Expansion parameters of ZnSe are presented; variables include wavelength, refractive index, and temperature coefficient; 3 figures and 3 tables include numeric data.

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N77-15835 Michigan Univ., Ann Arbor.
PLASMA CONFINEMENT IN NON-AXISYMMETRIC CLOSED MAGNETIC CONFIGURATIONS Ph.D. Thesis
Hussain Mahmoud Ahmed Rizik 1976 172 p
Avail: Univ. Microfilms Order No. 76-27578

Magnetohydrodynamic equilibrium and stability and classical diffusion were studied for non-axisymmetric magnetic configurations of plasma confinement significant to controlled thermonuclear reactions research. For a certain class of equilibria that has helicoidal symmetry in the vicinity of the magnetic axis the conditions were deduced in which this helicoidal symmetry approximates a plasma ring located around a closed non-planar curve with variable curvature and torsion. Equilibrium, classical diffusion, and localized perturbation criterion of stability were then studied for a plasma with a two variable helicoidal symmetry. The ideal MHD equilibrium was found for a toroidal plasma with non-circular cross section (elliptically or triangularly deformed) situated in a magnetic field with single non-planar magnetic axis, through which flows (in the forward and backward directions) longitudinal current with a flat profile. Dissert. Abstr.

N77-15836 Columbia Univ., New York.
PHYSICS OF A FUSION PLASMA BOUNDARY LAYER Ph.D. Thesis
Betty Jensen 1976 160 p
Avail: Univ. Microfilms Order No. 76-29320

A theoretical and computational study is made of plasma phenomena occurring when a hot, dense plasma containing a transverse magnetic field is brought into sudden contact with a cold metal wall. The effects caused by thermal conduction, plamsa convection, magnetohydrodynamic phenomena, atomic recombination and ionization, diffusion of neutral atoms which are formed near the wall, and radiation are studied. The time evolution of the plasma temperature, pressure, the charged and neutral particle concentrations, magnetic and electric field strengths, and the plasma current density in the neighborhood of the solid surface are investigated. The rate of energy transfer from the plasma to the wall is calculated, and the conditions under which wall surface melting occurs are estimated. Dissert. Abstr.

N77-15837 College of William and Mary, Williamsburg, Va.
STUDIES OF ION WAVE PROPAGATION IN INHOMOGENEOUS PLASMAS Ph.D. Thesis
Shiew-Luan Yang Hsieh 1976 106 p
Avail: Univ. Microfilms Order No. 76-28439

A model is described in which ions are accelerated against the direction of the electric field at a density gradient. A one-dimensional, inhomogeneous, steady-state is constructed, in which cold electrons stream relative to cold ions. The wavenumber and amplitude of the fluctuating potential are calculated. Trajectories of representative ions trapped in the potential troughs are computed. The propagation of short wavelength, small amplitude ion acoustic waves in inhomogeneous plasmas is studied, using fluid models which allow change separation. It is demonstrated that ion acoustic waves are not reflected at a plasma sheath, in general are somewhat damped in regions of subsonic ion flow, and may undergo significant growth in the plasma with increasing supersonic flow. The effect of magnetic shear due to a current on the ion acoustic instability is examined. Dissert. Abstr.

N77-15838 Wisconsin Univ., Madison.
OHMIC HEATING IN A SUPPORTED TOROIDAL QUADRUPOLE Ph.D. Thesis
William Charles Guss 1976 220 p
Avail: Univ. Microfilms Order No. 76-20109

Computer calculations of the average inductive electric field parallel to the magnetic lines of force are included which, along with the measured parallel current density, determined the average local conductivity. During the time that the parallel electric field was less than the Dreicer critical field, the conductivity changes. Possible phenomena, relating to magnetic mirrors and instabilities, are discussed in relation to the form of the conductivity. Several criteria for MHD stability are evaluated in connection with large low frequency current fluctuations in the region of an inverted density distribution. The measurement of, and the discharge sensitivity to, magnetic field perturbations is described. An energy balance experiment is performed during the heating. Dissert. Abstr.

N77-15839 Maryland Univ., College Park.
PLASMA HEATING AND DYNAMICS IN A THETA-PINCH Ph.D. Thesis
Robert Joseph Commisso 1976 140 p
Avail: Univ. Microfilms Order No. 76-27370

Using a variety of diagnostic techniques and 11 mtorr initial fill pressure H2 theta pinch plasma is studied. The diagnostics include magnetic and electric probes, high speed photography, visible and vacuum ultraviolet spectroscopy, and Thomson scattering. A model for the ion implosion dynamics is discussed in which the ions are coupled to the electrons through a charge separation electrostatic field. The potential associated with the field estimated spectroscopically. The results compare favorably with theoretical estimates and independent probe measurements. The observed electron and ion heating and ion thermalization are not consistent with classical heating and thermalization mechanism. Therefore, collisionless mechanisms must be evoked to consistently interpret the data. Dissert. Abstr.

N77-15840 New Mexico State Univ., University Park.
A NEW TREATMENT OF THE VLASOV EQUATION WITH APPLICATION TO THE ELECTRICAL CONDUCTIVITY OF A PLASMA HAVING ELECTRON-ION COLLISIONS AND COULOMB CORRELATIONS Ph.D. Thesis
Ralph Joseph Brewer 1976 134 p
Avail: Univ. Microfilms Order No. 76-26848

The collision-free Vlasov equation is solved and the current density is formed, from which the collisionless part of the electrical conductivity is found. The modified collision-dependent equation is then solved and the average force per unit charge on an electron is calculated; the equation of motion then yields the collision-dependent conductivity. The displacement of an electron relative to the fixed ions introduces a coupling between the collision-free and collision-dependent parts of the conductivity. A new integral, which is related to the complex error function, is introduced and studied. It is shown that the total conductivity exhibits different behavior for longitudinal and transverse external fields, even in the case of fields having infinite wavelength. It is also seen that resonances occur at the ion-acoustic and electron plasma frequencies. Dissert. Abstr.

N77-15841 Maryland Univ., College Park.
EQUILIBRIUM AND NONLOCAL STABILITY PROPERTIES OF COLLISIONLESS THETA-PINCH PLASMAS Ph.D. Thesis
Donald Byron Batchelor 1976 232 p
Avail: Univ. Microfilms Order No. 76-22364

The equilibrium and nonlocal stability properties of collisionless, high-beta, theta-pinch plasmas are investigated using a Vlasov description and using a two fluid description. The equilibrium configuration is assumed to be an infinitely long, azimuthally symmetric plasma column with currents purely in the azimuthal direction and magnetic field purely in the axial direction. The general procedure for constructing high-beta theta pinch equilibria within the framework of the steady state Vlasov-Maxwell equations is discussed. Properties are calculated for a number of sharp

boundary and diffuse boundary, rigid rotor Vlasov equilibria and general equilibrium relations that pertain to the entire class of rigid rotor equilibria are presented. A method is presented for reconstructing the distribution function of a rigid rotor equilibrium if the temperature, rotational frequency, and either the density or magnetic field profile is known. Dissert. Abstr.

N77-15842 North Carolina State Univ., Raleigh.
A TAPERED Z-PINCH AND ITS POTENTIAL USE FOR RELATIVISTIC ELECTRON BEAM FOCUSING Ph.D. Thesis
Frederick Wallace Baity, Jr. 1976 114 p
Avail: Univ. Microfilms Order No. 76-28458

The possibility of using a tapered Z-pinch discharge for the purpose of focusing and guiding an intense relativistic electron beam is examined. The nature of the collapse of the plasma column in a tapered Z-pinch in argon is studied experimentally and theoretically, with a snowplow model for the tapered Z-pinch being developed. The tapered Z-pinch is a linear Z-pinch with planar electrodes and with a tapered insulating tube having a smaller diameter at the anode than the cathode. Results from relativistic electron beam theory are used to estimate the magnitude of various effects expected in the interaction of a relativistic electron beam with a tapered Z-pinch. Two different modes of operation of a relativistic electron beam - tapered Z-pinch system for solid target irradiation are proposed and analyzed. One is ruled out as impractical, but the other appears promising for efficient transport and concentration of intense relativistic electron beams. Dissert. Abstr.

N77-15843 Maryland Univ., College Park.
MAGNETICALLY-CONFINED NONNEUTRAL PLASMA COLUMNS: RIGID ROTATION, EQUILIBRIUM SURFACE ENVELOPES, AND PARAMETRIC EXCITATION Ph.D. Thesis
Redge Allan Mahaffey 1976 178 p
Avail: Univ. Microfilms Order No. 76-28698

Because of the nonneutral plasma column radius is a function of axial position, many of the local properties of the plasma are also functions of axial position. Among other effects, this variation can modify the wave propagation properties of the column. It is predicted that the wavenumbers of excited spacecharge waves are varied as a function of axial position. This variation can result in sidebands in wavenumber space. Because the amplitude of oscillation of the surface ripple is asymmetric about the equilibrium radius, the oscillation of the wavenumbers is asymmetric about the wavenumber that would be excited on uniform beams. This causes a shift in the wavenumbers that has been observed experimentally. These effects may have important implications in microwave amplifiers which couple space-charge waves to resonant circuits. Dissert. Abstr.

N77-15844# Sandia Labs., Albuquerque, N.Mex.
NUMERICAL METHODS FOR STUDYING COMPRESSED MAGNETIC FIELD GENERATORS
John R. Freeman and Samuel L. Thompson 1976 12 p refs Presented at Intern. Conf. on Numerical Methods in Elec. and Magnetic Field Probl., St. Margherita, Italy, 30 May 1976 Sponsored by ERDA
(SAND-75-5527; Conf-760516-1) Avail: NTIS HC A02/MF A01

Explosively driven compressed magnetic field (CMF) power supplies have been used for a variety of applications. A two-dimensional MHD computational model, entitled COMAG, constructed to study the characteristics of helically wound CMF generators is described. The code combines an existing Eulerian materials response code with a 2-D magnetic field solver to compute the self-consistent interaction between the field and the conductors, including magnetic forces, Joule heating, and nonlinear resistive diffusion. ERA

N77-15845# Stanford Univ., Calif. Dept. of Mechanical Engineering.
ABSTRACTS: 1976 AFOSR CONTRACTORS' MEETING ON MHD POWER GENERATION AND LASERS
4 May 1976 58 p Conf. held in Stanford, Calif., 3-4 May, 1976
(Contract F44620-76-C-0024; AF Proj. 6813; AF Proj. 9752) (AD-A027654; AFOSR-76-0171TR) Avail: NTIS HC A04/MF A01 CSCL 10/2

The report consists of a collection of abstracts of the numerous research progress reports given by AFOSR contractors and of invited papers from other governmental agencies and contractors. These papers presented over a two-day period comprised the 1976 annual contractors meeting on MHD electric power generation and lasers. The principal investigators and their organizational association are also identified. GRA

N77-15846# General Atomic Co., San Diego, Calif.
FUSION REACTOR PHYSICS STUDIES IN THE dc OCTOPOLE Final Report
R. Prater, R. LaHaye, S. Wong, S. Ejima, C. Moeller, and P. Petersen Aug. 1976 110 p refs Sponsored by Elec. Power Res. Inst.
(PB-257552/0; EPRI-ER-215) Avail: NTIS HC A06/MF A01 CSCL 18A

An experimental study of the effect of plasma particle trapping in a nonuniform magnetic field is being carried out. This study is being done in the dc Octopole, a machine which has the capability of operating in the parametric regime in which the trapped ion modes are theoretically predicted to occur. GRA

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N77-15847 California Univ., Irvine.
TOPOGRAPHIC, ACOUSTIC AND MAGNETIC CRYSTAL WAVEGUIDES Ph.D. Thesis
Timothy Michael Sharon 1976 274 p
Avail: Univ. Microfilms Order No. 76-29278

The mechanical and electrical boundary conditions on the wedge are incorporated in the equation of motion by assuming position dependent elastic, dielectric and piezoelectric tensors. A double series expansion in Laguerre functions is used, both for the displacement components and the scalar potential. The propagation of elastic waves localized to the top of a semi-infinite, nonpiezoelectric cubic elastic rectangular ridge is studied. In this case, the displacement components are expanded in a double series made up of products of Legendre polynomials and Laguerre functions. Dissert. Abstr.

N77-15848 Georgetown Univ., Washington, D.C.
ELECTRONIC PROPERTY VARIATION OF N-TYPE InSb UNDER UNIAXIAL STRESS AT LIQUID HELIUM TEMPERATURES Ph.D. Thesis
John William Scully 1976 115 p
Avail: Univ. Microfilms Order No. 76-28883

Variation in the resistivity of n-type InSb is measured as a function of applied uniaxial stress at 4.2K. These observed values of resistivity changes were used to calculate the fundamental, piezoresistance and elastoresistance coefficients relating the sample resistivity change to applied stress and associated strain. Deformation potential constants relating the change of the electronic bands as a function of specific strains were calculated from the measured resistivity values and the expression relating the change of electron effective mass with applied stress. Dissert. Abstr.

N77-15849 California Univ., Los Angeles.
N-TYPE SWITCHING OF SEMICONDUCTORS IMMERSED IN CRYOGENIC LIQUIDS Ph.D. Thesis
George Domingo 1976 224 p
Avail: Univ. Microfilms Order No. 76-26882

The I-V characteristics of semiconductors immersed in cryogenic liquids were studied both under dc and pulsed conditions. Switching parameters were found both experimentally and theoretically. It was found that under pulsed conditions the threshold switching power is considerably decreased. It was shown that this thermal N-type switching has been repeatedly misinterpreted as an electronic mechanism, in particular to field induced (enhanced) trapping in Si counterdoped with deep double

impurities (S, Zn and Co). It seems very unlikely that field induced trapping can generate N-type switching in silicon at 77 K.
Dissert. Abstr.

N77-15850 Southern Methodist Univ., Dallas, Tex.
LOW BACKGROUND MICROWAVE-BIASED EXTRINSIC PHOTOCONDUCTORS Ph.D. Thesis
James Norman Crouch, Jr. 1976 144 p
Avail: Univ. Microfilms Order No. 76-29371

A theoretical and experimental description of low background microwave-biased extrinsic photoconductors is presented. A low frequency equivalent circuit model of such devices was developed. The model was postulated to be valid for microwave-biased extrinsic photoconductors operating at any background photon irradiance level. A low background microwave-biased mercury-doped germanium photoconductor experiment is described. The experimental results were seen to confirm the validity of the equivalent circuit model. Microwave-biased extrinsic photoconductors were shown to exhibit no sweepout effects. Data also indicated that microwave-biased extrinsic photoconductors are not constrained to performance values derived from sweepout-limited photoconductor theory. Consequently, microwave-biased extrinsic photoconductors were shown to be fast, high-gain IR detectors. Dissert. Abstr.

N77-15851 Georgia Inst. of Tech., Atlanta.
LOCAL ENVIRONMENT DEPENDENCE OF MAGNETIC MOMENT IN Ni-Cu ALLOYS Ph.D. Thesis
A. Rodrigo Medina 1976 87 p
Avail: Univ. Microfilms Order No. 76-29355

Moment disturbances in three ferromagnetic Ni-Cu alloys are measured with the polarized neutron technique. The data indicate that all the magnetic moment, including the negative magnetization previously assumed uniform, is to be associated with the Ni atoms. This agrees with the diffraction data and with the theoretical and experimental evidence that the Cu atoms keep their 3d shell almost full. The proposed nearest-neighbor magnetic environment model demonstrates that most of the moment disturbances produced by Cu in Ni are due to its nonmagnetic character, but that some nearest neighbor chemical disturbance must be included to explain the observed cross sections. The proposed model also describes the diffuse scattering of other nonmagnetic dilute impurities in Ni. Dissert. Abstr.

N77-15852 Georgetown Univ., Washington, D.C.
MEASUREMENT OF THE SUPERCONDUCTING ENERGY GAP ANISOTROPY IN SINGLE CRYSTAL GALLIUM BY SUPERCONDUCTOR-NORMAL METAL TUNNELING Ph.D. Thesis
Andrew John Grekas 1976 167 p
Avail: Univ. Microfilms Order No. 76-26794

Experiments are performed to answer some concerns regarding energy gap anisotropy. These experiments eliminate difficulties with a.c. electronics, negative resistance in S-S' junctions, temperature extrapolation of 2 delta (T)/kT sub c to T=0, noise pickup and, sample preparation. The d.c. I-V curves of 15 N-S Ag(film)-Ga(crystal) tunnel junctions at 12 orientations in the Ga A-B plane (grown in a controlled environment room) were measured in a dilution refrigerator (T/T sub c approximates 0.1) in a well shielded room. The data were digitized and fit to BCS-based theoretical I-V curves. The precision of 2 delta (O)/kT sub c in the fits is 3-5 x 0.001% and the repeatability is 0.3%. 2 delta (O)/kT sub c varies by 7% from the Ga A to B axis in good agreement with prior measurements. Dissert. Abstr.

N77-15853 Rensselaer Polytechnic Inst., Troy, N.Y.
A CALCULATION OF THE HIGH TEMPERATURE TRANSPORT PROPERTIES OF ZINC Ph.D. Thesis
Thomas Charles Genoni 1976 86 p
Avail: Univ. Microfilms Order No. 76-27194

The electromigration of a weak scattering impurity in a Bloch electron gas is reconsidered while taking into account the conduction electron screening in the Hartree approximation. Our formal expression for the driving force depends explicitly on the dielectric matrix, and reduces to previously derived formulas in the appropriate limits. Dissert. Abstr.

N77-15854 City Univ. of New York.
PRESSURE EFFECTS ON THE BAND STRUCTURE AND HALL MOBILITY OF NAPHTHALENE Ph.D. Thesis
Mahmoud Aly ElHamamsy 1976 195 p
Avail: Univ. Microfilms Order No. 76-27217

The variation with pressure of the Hall and drift mobility tensors of naphthalene were obtained in the relaxation time approximation. By assuming the relaxation time in a particular direction to be inversely proportional to the bandwidth in that direction, it is found that the anisotropies of the drift mobility tensor are in good agreement with the predictions of a band model that takes into consideration the resonance and exchange integrals, as well as the intramolecular vibrations, and for which the mean free path rather than the mean free time tau is constant. To verify this result, the pressure dependence, up to 2.2 kilobars, of the Hall mobility tensor of naphthalene was determined. Measurements were carried out along the directions that gave the largest Hall signal; these correspond to the current and magnetic field along either the a or b axes. Dissert. Abstr.

N77-15855 Missouri Univ., Rolla.
ABSORPTION IN THE INFRARED OF SURFACE ELECTROMAGNETIC WAVES BY ADSORBED MOLECULES ON A COPPER SURFACE Ph.D. Thesis
Kulbhushan Bhasin 1976 60 p
Avail: Univ. Microfilms Order No. 76-26852

Experimental observations have been made for the first time that surface electromagnetic wave spectroscopy can be used to measure the infrared spectra of adsorbed molecules and very thin films on metal surfaces. Using a tunable CO2 laser the resonances of thick physisorbed benzene on copper were observed. Broadening of these resonances for the thinnest layers of benzene was observed. Spectroscopy and ellipsometry were also used to study thin films of cellulose acetate on copper. It was shown that film thicknesses determined by spectroscopy are in agreement with the ellipsometric thicknesses. Dissert. Abstr.

N77-15856 Notre Dame Univ., Ind.
A STUDY OF MACROSCOPIC QUANTUM PHASE COHERENCE PROPERTIES OF A COUPLED SUPERFLUID 4He SYSTEM Ph.D. Thesis
Thomas Yuh-Gen Chai 1976 145 p
Avail: Univ. Microfilms Order No. 76-24982

The macroscopic quantum phase coherence properties for a system of two superfluid helium samples coupled to each other through a small orifice are explored. The presence of the phase coherence properties in coupled superfluid helium system is expected due to the analogy between the superfluidity of the superconductors and of liquid helium; and the detection of these quantum phase coherence phenomena in coupled superfluid helium systems is of substantial theoretical and experimental interest. Two different types of experiments are performed using this coupled superfluid He-4 system; the driven-flow experiment and the free-flow experiment. Certain features are observed that are similar to the features in the current-voltage characteristics of coupled superconductors. Dissert. Abstr.

N77-15857 California Univ., Davis.
THEORETICAL STUDIES OF THE ELECTRONIC PROPERTIES OF TRANSITION METALS AND TRANSITION METAL COMPOUNDS Ph.D. Thesis
Joseph Francis Alward, Jr. 1976 124 p
Avail: Univ. Microfilms Order No. 76-28953

An efficient new technique is presented for rapidly determining a near-optimum pseudopotential for use in electronic energy band structure calculations. The electronic energy band structures of TiC and ZrC are obtained and the corresponding reflectivity spectra are in fair agreement with the data. The TiC wavefunctions have been used to determine the electronic charge distribution in the (100) plane, and the results indicate that there is a net transfer of electronic charge from the titanium atom to the carbon atom. By also calculating the energy band structures of TiN and ZrN, and comparing with the carbide results, it is shown that the rigid-band model is not valid. Dissert. Abstr.

N77-15858 California Inst. of Tech., Pasadena.
SOME LUMINESCENCE PROPERTIES OF EXCITED SILICON AT LOW TEMPERATURES Ph.D. Thesis

Robert Bruce Hammond 1976 89 p
Avail: Univ. Microfilms Order No. 76-27771

Detailed studies of the luminescence due to the recombination of nonequilibrium electrons and holes in Si are reported for the temperature range 2-16 K. The properties of the exciton and electron-hole condensate luminescence are investigated in the spectral range from 1.11 micron to 1.17 micron. The Si was excited by laser pumping and by electrical injection. The temperature dependence of the intensity ratio of the LO- to TO-phonon assisted exciton recombination luminescence in laser excited, high purity Si is reported. The ratio is found to differ from that observed in absorption and to vary from 0.3 at 2 K to 0.1 at 13 K. The variation of the ratio with temperature is shown to be due to the splitting of the ground state of the exciton by several tenths of a meV. The relevance of these results to the recombination from the electron-hole condensate in Si is discussed. Dissert. Abstr.

N77-15859 State Univ. of New York, Buffalo.
ELECTRONIC PROPERTIES OF METALS AT LOW TEMPERATURES Ph.D. Thesis
David Yutaka Kojima 1976 72 p
Avail: Univ. Microfilms Order No. 76-26537

A many body theory of an electron gas is developed to find the internal and correlation energies at low but finite temperatures. The contribution from the first order exchange, second order (regular and anomalous) exchange, and ring diagrams are treated. The Fermi momentum and the correlation energy are determined as functions of the density by two different methods, one being based on iteration and the other a direct solution of the number density relation. It was found that the iterative solutions which are correct to order e squared or e to the fourth power become negative for r sub s of order 5 while the direct solutions do not, indicating the invalidity of the former. Hence, the correlation energy evaluated to the same orders by iteration will not be satisfactory in the same range. Dissert. Abstr.

N77-15860 Columbia Univ., New York.
THE NONLOCAL THEORIES OF ELASTICITY FOR A FINITE CRYSTAL Ph.D. Thesis
Farid Shahid-Noorai 1976 80 p
Avail: Univ. Microfilms Order No. 76-28315

The strain energy of the deformed crystal is expressed in terms of the sums of all the interactions of pairs of mass points. These summations are then replaced by the appropriate integrals which were obtained in the derivations of the three dimensional Euler sum formula. The displacement equations of equilibrium and the independent boundary conditions are derived through the respective utilization of the nonlocal variational principle for the double integral theory and of the local variational principle for the theory containing only the gradient of the displacement components. The initial stresses and the surface effects are also examined in the light of the new developments. Dissert. Abstr.

N77-15861*# Scientific Translation Service, Santa Barbara, Calif.
SPECIFIC HEAT BETWEEN 1.4 AND 4.4 K IN THE PRESENCE OF A MAGNETIC FIELD VARYING FROM 0 TO 40 kG OF A GRAPHITE IRRADIATED BY NEUTRONS
P. Delhaes, Michel-Yves Lemerle, and Gilbert Blondet-Gonte Dec. 1976 8 p refs Transl. into ENGLISH from Compt. Rend., Ser. B, Sci. Phys. (France), vol. 272, no. 23, 7 Jun. 1971 p 1285-1288
(Contract NASw-2791)
(NASA-TT-F-17316) Avail: NTIS HC A02/MF A01 CSCL 20L

Specific heat was measured in the presence of an intense magnetic field in order to artificially create a Schottky anomaly resembling that existing in certain substances possessing an internal magnetic field. To do this it was necessary to apply, on a sample containing localized paramagnetic centers, an external magnetic field such that the magnetic energy was of the same order of magnitude as the thermal energy. An artificial graphite irradiated by neutrons was used to obtain supplementary information relative to the energy distribution levels upon which single electrons are found. A magnetic component of the specific heat related to the existence of stable paramagnetic centers is thus demonstrated. Author

N77-15862*# Kanner (Leo) Associates, Redwood City, Calif.
NEW TERNARY-PHASE MOLYBDENUM SELENIDES
M. Sergent and R. Chevrel Washington NASA Nov. 1976 11 p refs Transl. into ENGLISH from J. of Solid State Chem. (France), v. 6, no. 3, 1973 p 433-437
(Contract NASw-2790)
(NASA-TT-F-17319) Avail: NTIS HC A02/MF A01 CSCL 20L

The synthesis and crystal properties of new selenides of formula MxMo3Se4 are described. Author

N77-15863*# Scientific Translation Service, Santa Barbara, Calif.
STUDY OF THE STRUCTURE OF MOLYBDENUM SULFIDE AND SELENIDE COMPOUNDS. 2: CRYSTAL STRUCTURE OF Ni SUB 0.33Mo3Se4
O. Bars, J. Guillevic, and D. Grandjean Washington NASA Nov. 1976 11 p refs Transl. into ENGLISH from J. of Solid State Chem. (France), v. 6, 1973 p 335-339
(Contract NASw-2791)
(NASA-TT-F-17320) Avail: NTIS HC A02/MF A01 CSCL 20L

The crystals of Ni0.33Mo3Se4, are triclinic, with two formula units in a cell. The structure was solved by analogy with Mo3Se4 and refined by a full-matrix least squares program to R = 0.093 for 822 independent reflections. The channels present in Mo3Se4 are occupied by Ni so that Ni0.33Mo3Se4 is always a metallic compound. Author

N77-15864*# Kanner (Leo) Associates, Redwood City, Calif.
STRUCTURAL STUDY OF MOLYBDENUM SULFIDES AND SELENIDES. 3: CRYSTAL STRUCTURE OF NICKEL MOLYBDENUM SULFIDE (NiMo3S4)
J. Guillevic, O. Bars, and D. Grandjean Washington NASA Nov. 1976 11 p refs Transl. into ENGLISH from J. Solid State Chem. (France), v. 7, no. 2, 1973 p 158-162
(Contract NASw-2790)
(NASA-TT-F-17321) Avail: NTIS HC A02/MF A01 CSCL 20L

The crystals of NiMo3S4 are rhombohedral, space group R bar 3, with a 6.462 A, alpha 94.68 deg, and Z = 2. The structure was solved by the heavy atom method and refined by a full-matrix least-squares program to R = 0.077 for 1026 independent reflections. The arrangement of Mo and S atoms in the cell is approximately the same as described before for Mo and Se atoms in Mo3Se4 and Ni0.33Mo3Se4; the Ni atoms are situated along the channel based on x = 0, y = 0. However, in these two compounds the lattice of Se presents a covalent character, whereas the lattice of S in NiMo3S4 has an essentially ionic character. Author

N77-15865*# Scientific Translation Service, Santa Barbara, Calif.
MECHANISM OF SPIN-LATTICE RELAXATION IN DEGASSED NATURAL CARBONS; ROLE OF EXCHANGE INTERACTIONS
G. Bellessa Washington NASA Dec. 1976 8 p refs Transl. into ENGLISH from Compt. Rend. (Paris), v. 260, no. 6, 1965 p 1610-1613
(Contract NASw-2791)
(NASA-TT-F-17327) Avail: NTIS HC A02/MF A01 CSCL 20L

The relaxation spin-lattice times of the different degassed natural carbons are measured in the paramagnetic center, in the region of high concentrations and in the absence of oxygen. The relaxation mechanism, by a system of exchange interactions, does not explain a variation of (T sub 1) with concentrations in the paramagnetic center. The interpretation of this variation by a mechanism of the diffusion energy within a system of heterogeneous spins is proposed. Author

N77-15866*# Scientific Translation Service, Santa Barbara, Calif.
MODIFICATION OF THE MODEL OF SLONCZEWSKI AND WEISS APPLICABLE TO PREGRAPHITIC CARBON
A. Marchand Washington NASA Dec. 1976 9 p refs Transl. into ENGLISH from Compt. Rend. (Paris), v. 256, 1963 p 3070-3073
(Contract NASw-2791)
(NASA-TT-F-17328) Avail: NTIS HC A02/MF A01 CSCL 20L

A modification of the model of Slonczewski and Weiss is proposed to represent the energy levels of the pi electrons of pregraphitic carbon in the neighborhood of the Brillouin zone. The model is based on the existence of feeble interactions between the graphite planes and a forbidden band between the valence and conduction bands. The new model makes possible a calculation of the energy level density. Author

N77-15867*# Scientific Translation Service, Santa Barbara, Calif.
THE -g FACTOR ANISOTROPY OF POWDERED SAMPLES OF MADAGASCAR GRAPHITE CONTAINING A RHOMBOHEDRAL PHASE
P. Delhaes Washington NASA Jan. 1977 22 p refs Transl. into ENGLISH from Carbon (France), v. 6, no. 6, 1968 p 925-935
(Contract NASw-2791)
(NASA-TT-F-17335) Avail: NTIS HC A02/MF A01 CSCL 20L

The g factor of polycrystalline high temperature carbon and graphite was measured. A special sample was prepared by dispersing platelet particles in liquid paraffin, orienting them in a magnetic field, and quickly freezing the paraffin. The method of g factor determination is described and results obtained with several Madagascar graphites containing various amounts of rhombohedral phase are reported. The determination of the anisotropy of the rhomobohedral structure was unsuccessful. Author

N77-15868*# Scientific Translation Service, Santa Barbara, Calif.
PARAMAGNETIC RESONANCE OF FREE CHARGE CARRIERS. TEMPERATURE VARIATION OF THE LINEWIDTH ANISOTROPY IN SINGLE CRYSTAL GRAPHITE
Pierre Delhaes Washington NASA Jan. 1977 8 p refs Transl. into ENGLISH from Compt. Rend., Ser. A, B (France), v. 265B, no. 9, 1967 p 575-578
(Contract NASw-2791)
(NASA-TT-F-17343) Avail: NTIS HC A02/MF A01 CSCL 20L

The width of the graphite resonance line was measured at two temperatures and found to change with changes in the angle between the c axis and the magnetic field. The temperature dependence of the linewidth anisotropy showed that the ratio between the main anisotropies is two. Author

N77-15869*# Kanner (Leo) Associates, Redwood City, Calif.
AN ELECTRON PARAMAGNETIC RESONANCE STUDY OF ANNEALING EFFECTS IN IRRADIATED GRAPHITE
T. Kester and P. Servoz-Gauin Washington NASA Dec. 1976 9 p refs Transl. into ENGLISH from Etude par resonance paramagnetique electronique des effets de recuit dans le graphite irradie, Compt. Rend., Academie des Sciences, Ser. A and B, France (Grenoble), v. 262B, no. 6, 1966, p 439-442
(Contract NASw-2790)
(NASA-TT-F-17344) Avail: NTIS HC A02/MF A01 CSCL 20L

Samples of powdered graphite were irradiated with fast neutrons at 77 K. The samples were then homogenized at 77 K with SiO2 powder so that electrical contact between C granules was minimized. The resultant E.P.R. signal was symmetrical and its g and line width were measured as the samples were warmed from 77 K to 573 K. The magnetic susceptibility was also measured at each temperature. Author

N77-15870*# Scientific Translation Service, Santa Barbara, Calif.
THERMAL VARIATIONS OF THE DIAMAGNETISM AND HALL EFFECT OF POLYCRYSTALLINE GRAPHITE DOPED WITH BORON
Pierre Delhaes and Andre Marchand Washington NASA Jan. 1977 8 p refs Transl. into ENGLISH from Compt. Rend. (France), v. 259, no. 1, 1964 p 123-126
(Contract NASw-2791)
(NASA-TT-F-17345) Avail: NTIS HC A02/MF A01 CSCL 20L

Graphite, made from coke derived from pitch, was impregnated with H3BO3 and heated at 1350 deg for 3 hrs. followed by heating in an inert atm. at 2300 deg for varying lengths of time. The diamagnetic susceptibility decreased as the B concentration was increased from 0.4 to 1%. For a given B concentration, the susceptibility varied with the time of heating at 2300 deg and passed through a min. The change of diamagnetism with temperature decreased with the time of heat treatment. The displacement of the Fermi level was calculated from the susceptibility measurements and compared with that calculated from the observed temperature variation of the Hall coefficient. The results agreed satisfactorily. Author

N77-15871*# Kanner (Leo) Associates, Redwood City, Calif.
THEORETICAL AND EXPERIMENTAL PARAMAGNETISM OF PREGRAPHITIC CARBON
A. Marchand and P. Delhaes Washington NASA Dec. 1976 9 p refs Transl. into ENGLISH from Compt. Rend. (France), v. 256, 1963 p 3296-3299
(Contract NASw-2790)
(NASA-TT-F-17346) Avail: NTIS HC A02/MF A01 CSCL 20L

The variation in paramagnetism of carbon during graphitization was calculated by using the model of Slonczewski and Weiss. The results were in agreement with experimental results obtained by electron resonance measurements made on a series of cokes and made from tar and heated at 1620 to 2850 deg. Author

N77-15872*# Kanner (Leo) Associates, Redwood City, Calif.
IDENTIFICATION OF THE SYSTEM C-2 SIGMA + TO X-2 PI I OF OH AND OD IN THE VACUUM ULTRA-VIOLET
P. Felenbok and J. Czarny Washington NASA Jan. 1977 8 p refs Transl. into ENGLISH from Ann. Astrophys. (Paris), v. 27, no. 4, 1964 p 244-246
(Contract NASw-2790)
(NASA-TT-F-17371) Avail: NTIS HC A02/MF A01 CSCL 20L

Between 1770 and 1990 A, a system of bands with a weak vibrational structure is observed in the spectra of the vapors of water and heavy water. An attempt is made to identify this system with a transition C2 sigma (+) to X2 pi sub i of OH and OD by extrapolating the constants from the ground state for which they are known to be in the dissociated state. The conclusion is that the dissociated state X2II sub i is observed. Author

N77-15873*# Oregon Univ., Eugene. Dept. of Physics.
AUGER AND RADIATIVE DEEXCITATION OF THE 1s2l3l PRIME CONFIGURATIONS OF LITHIUM-LIKE NEON
Mau Hsiung Chen [1976] 20 p refs
(Grants NGR-38-003-036; DAHC04-75-G-0021)
(NASA-CR-149388) Avail: NTIS HC A02/MF A01 CSCL 20L

The three-electron configurations of 1s2lambda3lambda of neon are observed in ion-atom collisions and beam foil excitation. Multiplet Auger and X-ray transition rates obtained in intermediate coupling are calculated. Fluorescence yields are also computed. Author

N77-15874# Sandia Labs., Livermore, Calif.
DEPTH PROFILES OF DEUTERIUM IN TITANIUM FROM GAS EMISSION DURING SPUTTERING
R. G. Musket Feb. 1976 16 p refs Presented at 2d Intern. Conf. on Surface Effects in Controlled Fusion Devices, San Francisco, 16 Feb. 1976
(Contract AT(29-1)-789)
(SAND-75-8754; Conf-760209-24) Avail: NTIS HC A02/MF A01

A simple technique for the determination of the depth distributions of deuterium and tritium in the near surface region (01 micrometer) of materials has been demonstrated. In particular, the depth distribution of deuterium in a layered, deuterided titanium film has been determined by monitoring the HD and D2 gas emissions during sputtering by 2 keV argon ions. GRA

N77-15875# Dayton Univ., Ohio.
MOLECULAR ORBITAL EFFECTS ON THE Ti LMV AUGER SPECTRA OF TiO AND TiO2 Technical Report, Apr. - Sep. 1974
J. S. Solomon and W. L. Baun (AFML) Wright-Patterson AFB, Ohio AFML Jun. 1976 14 p refs
(Contract F33615-73-C-5099; AF Proj. 7340)
(AD-A027557; AFML-TR-76-69) Avail: NTIS HC A02/MF A01 CSCL 07/4

The fine features of the Auger valence band spectra of TiO and TiO2 have been related to transitions arising from oxygen 2s and titanium 3d, 4s molecular orbitals. The N(E) valence band spectra have been unfolded and the resulting components correlated with X-ray emission data and a molecular orbital (MO) model. Differences in spectral shapes are shown to be linked with differences in the density of state of oxygen-titanium molecular orbitals. GRA

N77-15876# Watervliet Arsenal, N.Y. Benet Weapons Lab.
UNIQUE MATERIALS AND PROPERTIES IN THE NEW HIGH PRESSURE-TEMPERATURE REGIME ABOVE 250 KBARS
Thomas E. Davidson, David P. Kendall, Clarke G. Homan, Julius Frankel, and Frederick J. Rich May 1976 13 p refs
(AD-A025990/3) Avail: NTIS HC A02/MF A01 CSCL 20L

A concept for generating static high pressures resulted in the achievement of pressures exceeding 400 kbars with a sample volume of .015 cc. Substitution of diamond for tungsten carbide anvils and multiple staging should increase the attainable pressures to near 1000 kbars. The pressure system was successfully coupled with a cryogenic capability to 10 K. An ultrasonic measurement technique was developed for use at high pressure which by measuring shear and longitudinal velocity, yields density as a function of pressure. A dielectric system was developed for detecting of transitions and measurement of density. The P-T diagram for bismuth was increased to 140 kbars with the discovery of two new phases, one of which may be superconducting to high temperature. New electronic transitions at room temperature have been discovered in GaP (216 kbars), NaCl (290 kbars), and Bi 6 to 9 (320 kbars). In the latter, the resistivity is less than that of copper. GRA

N77-15877# Lehigh Univ., Bethlehem, Pa. Dept. of Physics.
CORRELATIONS OF THE 4.77 eV-4.28 eV LUMINESCENCE BAND IN SILICON DIOXIDE WITH THE OXYGEN VACANCY Final Report, 1 Jul. 1975 - 30 Jun. 1976
Colin E. Jones and David Embree 15 Jul. 1976 39 p refs
(Contract N00014-67-A-0370-0009)
(AD-A027296; Scientific-10) Avail: NTIS HC A03/MF A01 CSCL 20/12

A luminescence band observed at 4.77 eV (260 nm) in crystalline and at 4.28 eV (290 nm) in amorphous silicon dioxide has been found to correlate with optical and spin resonance measurements of oxygen vacancy concentrations in a series of irradiated samples. The 4.28 eV (290 nm) band has also been observed in the silicon dioxide layer of metal-oxide semiconductor (MOS) devices. The intensity of the bands can be increased by chemical reduction in carbon monoxide vapor or decreased by heating in oxygen or water vapor. The 4.28 eV (290 nm) luminescence intensity in the MOS samples also seems to be related to the trapped positive charge in the silicon dioxide. These facts all support a model for the luminescence center as being the oxygen vacancy. Author (GRA)

N77-15878# Naval Ship Research and Development Center, Bethesda, Md. Propulsion and Auxiliary Systems Dept.
SEARCH FOR ORGANIC SUPERCONDUCTORS
Ernest H. Halpern Jun. 1976 159 p refs
(ZR0000101)
(AD-A026236; DTNSRDC-76-0090) Avail: NTIS HC A08/MF A01 CSCL 20/3

Five salts (and acids) of bile were examined both magnetically and electrically to determine the properties of these salts with respect to their possible behavior as organic superconductors. It was found that these materials have characteristics that are similar in some respects to metallic superconductors. Specifically, the following properties were observed or reduced: These materials are bulk insulators. Small inclusions within the materials due to clustering of the carboxylate groups produce diamagnetic shifts with temperature. The diamagnetic frequency shifts respond to magnetic fields in a way similar to that of a metallic superconductor. With sodium desoxycholate, a field of 8.1 kilogauss destroys the diamagnetic shift. Each of the salts or acids were similarly structured, differing only in the number of OH groups attached to the ring section (R group). On removing any OH group from the ring section, the transition temperature was observed to approximately double. Sodium cholate which has three OH groups was observed to have a transition temperature of 30 K. Sodium desoxycholate which has two OH groups was observed to have a transition temperature of 60 K. Sodium cholanate which has no OH group was observed to have a transition temperature of 277 K. By measurement of the dissipation of the bulk compound, it was observed that the island clusters had a marked increase in conductivity at the transition temperature. This increase was similar to that observed of a 6% by volume mixture of niobium powder and an organic insulator (Sodium desoxycholate in this case). The frequency shifts were experimentally shown not to be attributed to dielectric effects. GRA

N77-15879# Cornell Univ., Ithaca, N.Y. School of Electrical Engineering.
NEGATIVE MICROWAVE CONDUCTIVITY IN SOLIDS Final Report, Sep. 1971 - Mar. 1976
Charles A. Lee and J. Frey 26 May 1976 7 p refs
(Grant AF-AFOSR-2036-71; AF Proj. 9763)
(AD-A026307; AFOSR-76-0717TR) Avail: NTIS HC A02/MF A01 CSCL 20/2

The feasibility of obtaining bulk negative conductivity from a superlattice induced by a high intensity acoustic wave at 3 and 9 GHz in InSb was analyzed and tested. The result was negative due to excessive coupling of acoustic energy to the electron distribution. Technology for fabricating ultrafine gratings and surface superlattices by ion implantation has been perfected. An analysis of surface wave electromagnetic propagation to utilize the surface superlattice has been done. Single crystal ReO3 was examined for possible negative mass effects. New mechanisms for vapor growth of large single crystals of ReO3 were developed and the dc conductivity Hall effect, heat capacity, and magnetic susceptibility were measured. A Monte Carlo analysis of electron transport in superlattices was begun and led to successful studies (supported by other grants) of transient conduction behavior of GaAs and InP. A paper feasibility study of an electron interference technique for fabricating gratings in the range of 300-3000A has been made. Author (GRA)

N77-15880# Hughes Research Labs., Malibu, Calif.
SOLID PHASE EPITAXIAL GROWTH Annual Progress Report, 1 May 1975 - 30 Apr. 1976
C. L. Anderson and J. A. Roth Jun. 1976 35 p refs
(Contract N00014-75-C-0957)
(AD-A027441) Avail: NTIS HC A03/MF A01 CSCL 20/2

The preliminary results of an investigation designed to determine the effects of process-related interfacial and bulk contamination upon the physical and electrical properties of Si films grown by solid phase epitaxy (SPE) are reported. For control purposes, uncontaminated Si films were grown and characterized, starting from thin-film crystal-Si/Pd/amorphous-Si structures fabricated in ultrahigh vacuum. Comparison of defects observed in these films with films grown in the presence of known contamination by other workers suggests that some intentional contamination may be necessary for growth of high quality layers by the SPE process. GRA

N77-15881# New York Univ., N.Y. Dept. of Physics.
COOPERATIVE ELECTRONIC TRANSITIONS: STRUCTURAL TRANSFORMATIONS Final Report, 1 Jun. 1973 - 31 May 1976
Samuel J. Williamson 28 Jun. 1976 9 p refs
(Grant DA-ARO(D)-31-124-73-G158)
(AD-A027438; ARO-11125.4-P) Avail: NTIS HC A02/MF A01 CSCL 20/12

Experimental and theoretical studies of the electronic properties and lattice instability of the A-15 crystal class of high temperature superconductors have been completed. Experimental investigation of the structural instability in V3Si single crystals, a prototype sample in this class, and accompanying theoretical formulation of the relevant electronic density of states N(E) has shown that the form of N(E) is very sensitive to electron lifetime. The addition of defects in the lattice causes important changes in N(E) and stabilizes the cubic phase lattice. A new band structure model has been developed for A-15 high temperature superconductors based on a group theoretical approach whose key features are in agreement with less accurate band structure calculations. Experiments demonstrate that the

complications of spin-orbit coupling in the prototype A-15 compound V3Si can be neglected. Preliminary measurements of the thermal expansion in a number of crystals below 77K are complete, and the work is being extended to higher temperatures (approx. 500K) to investigate the influence of a superlattice development first reported by Schmidt et al. at Bell Laboratories. Electrical resistivity studies reveal a common behavior for all technologically important A-15 materials, which we have interpreted as arising from interband electron-phonon scattering. GRA

N77-15882# Air Force Materials Lab., Wright-Patterson AFB, Ohio.

MOLECULAR SPECTROSCOPY BY INELASTIC ELECTRON TUNNELING Final Report, Oct. 1973 - Oct. 1974

Kenneth P. Roenker Jun. 1976 33 p refs Presented at the Conf. on Elec. Insulation and Dielec. Phenomena, Downington, Pa., 21-23 Oct. 1974

(AF Proj. 7340)

(AD-A027187; AFML-TR-76-75) Avail: NTIS HC A03/MF A01 CSCL 20/12

This report examines the capabilities and limitations of the technique of inelastic electron tunneling (IET) as a molecular spectroscopic tool for surface studies. Following a brief review of the literature, an outline of the theory is given and the experimental technique discussed. The tunneling spectra of both clean and doped Al-Al oxide-Pb junctions are considered in detail. A comparison with existing surface analysis techniques concludes the report. Author (GRA)

N77-15883# McDonnell-Douglas Research Labs., St. Louis, Mo.

PREPARATION AND CHARACTERIZATION OF HgCdSe ALLOYS Final Report, 20 May 1974 - 31 Dec. 1975

Charles R. Whitsett, James G. Broerman, James G. Nelson, and Christopher J. Summers 31 Jan. 1976 146 p refs

(Contract N00014-74-C-0318)

(AD-A027203; MDC-Q0591) Avail: NTIS HC A07/MF A01 CSCL 20/12

The objectives of this research were to prepare single crystals of various compositions of Hg(1-x)Cd(x)Se alloys and to evaluate the 77-296 K performance capability of these alloys as detectors of infrared radiation, 2.05 micrometer wavelength radiation in particular. The initial plan involved the following three tasks: (1) Prepare single-crystal Hg(1-x)Cd(x)Se alloys with x-values of 0.18, 0.26, and 0.38. Anneal the alloys in Hg-vapor, vacuum, and Se-vapor to obtain a wide range of extrinsic electron concentrations; (2) Measure the Hall coefficient and electrical conductivity of each annealed Hg(1-x)Cd(x)Se alloy over the temperature range of 4.2-296 K; and (3) Measure the photoconductivity from 1 to 10 micrometer wavelength of each annealed alloy at 77, 195, and 296 K. Measure the photoconductive-response rise and decay times in the wavelength range of detector utilization of each alloy. GRA

N77-15884# Michigan Univ., Ann Arbor. Electron Physics Lab.

A TWO-DIMENSIONAL SIMULATION OF MESFETS

J. J. Barnes May 1976 235 p refs

(Contract F30602-74-C-0012; AF Proj. 5573)

(AD-A026413; RADC-TR-76-153; TR-136) Avail: NTIS HC A11/MF A01 CSCL 09/5

During the 1960's the bipolar junction transistor (BJT) was making steady progress in operating in the low GHz range as the active device in linear amplifier systems. Now the state-of-the-art junction field-effect transistor (JFET), in particular the metal semiconductor FET (MESFET), promises to supplant the BJT for microwave operation while utilizing its inherent majority carrier device noise advantage. Although the JFET was investigated by Shockley in 1952, its development lagged that of the BJT due to fabrication difficulties. Present performance of the JFET has improved due to the ability of present technology to produce well-defined, narrow-gate devices (0.5 micrometers at present), since JFET performance is limited mostly by gate length. Speculatively, operation of the GaAs MESFET will be pushed toward operation at 50 GHz or greater with significant gain to allow MESFET cascades to be used for large gain at microwave frequencies. GRA

N77-15885# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Physics.

INVESTIGATION IN SOLID STATE PHYSICS: MAGNETIC INSULATORS AT LOW TEMPERATURES Final Report, 1 Feb. 1970 - 31 Jan. 1976

Simeon A. Friedberg 20 Jul. 1976 9 p refs

(Contracts N00014-67-A-0314-0006; N00014-75-C-0771; NR Proj. 018-301; NR Proj. 318-026)

(AD-A027609) Avail: NTIS HC A02/MF A01 CSCL 20/3

A brief summary is given of the important results of a series of investigations of low temperature properties of certain transition metal salts which result from interactions of the paramagnetic ions. The materials studied include compounds with isolated spin clusters, linear chains of spins, 2 and 3 dimensional spin arrays, and singlet ground state systems. A detailed list of all technical reports and publications describing this work is given. Author (GRA)

N77-15886# Army Materials and Mechanics Research Center, Watertown, Mass. Materials Sciences Div.

GRAIN BOUNDARY DISLOCATIONS IN NONCUBIC CRYSTALS. 1: THE MODEL Final Report

Gordon A. Bruggeman and George H. Bishop, Jr. Mar. 1976 26 p refs

(DA Proj. 1T1-61102-B-32A)

(AD-A026096; AMMRC-TR-76-6) Avail: NTIS HC A03/MF A01 CSCL 20/2

A model is developed for the dislocation structure of grain boundaries in noncubic crystals. Important differences are noted between the grain boundary dislocation (GBD) description of boundaries in cubic and noncubic crystals. In both types of crystals the GBD's are present to preserve low-energy patterns characteristic of exact coincidence-site lattices (CSL's). In cubic crystals exact three-dimensional CSL's can be found for rotations about any axis. In noncubic crystals, however, exact three-dimensional CSL's exist only in special circumstances; in general, only near-coincidence site lattices (near-CSL's) can occur in three dimensions. When only near-coincidence is possible an additional component to the GRB array is necessary to compensate for the distortion implicit in near-coincidence. In twist boundaries this additional component alters the spacing of dislocations in the screw grid. Moreover, it is impossible to obtain a twist boundary free of GBD's. The minimum dislocation content occurs at misorientations at which exact coincidence exists in a single plane parallel to the twist axis, i.e., when an exact two-dimensional CSL exists, in which case a single set of screw GBD's parallel to the plane of exact coincidence is present. In tilt boundaries two dislocation arrays may be necessary: an array of pattern-preserving dislocations and an array of misfit dislocations. The function of the former array is to preserve the low-energy coincidence pattern on either side of the GBD; the function of the misfit array is again to compensate for the distortion inherent in near-coincidence. GRA

N77-15887# Army Materials and Mechanics Research Center, Watertown, Mass. Material Sciences Div.

GRAIN BOUNDARY DISLOCATIONS IN NON CUBIC CRYSTALS. 2: THE GBD MODEL APPLIED TO GRAIN BOUNDARY FACETS IN Final Report

Gordon A. Bruggeman and George H. Bishop, Jr. Mar. 1976 26 p refs

(DA Proj. 1T1-61102-B-32A)

(AD-A026097; AMMRC-TR-76-11) Avail: NTIS HC A03/MF A01 CSCL 20/2

Observations of faceting of -1010= tilt grain boundaries in zinc and a coincidence structural unit model were reported in earlier papers. The facet inclinations were found to be monotonic functions of boundary misorientation in certain misorientation ranges. In this paper, the grain boundary dislocation (GBD) model developed earlier is used to describe the structure of these faceted boundaries. The model, which assumes the Burgers vector of the GBD's to be lattice vectors of the complete-pattern-shift or DSC lattice derived from near-coincidence arrays in hcp crystals, is able to account for the experimentally observed changes in boundary inclination with misorientation. Observed facet morphologies are obtained with only certain GBD's, the core structures of which are shown to be equivalent to the stuctural units in the previously suggested structural unit model. Thus,

the application of the GBD model to more general boundaries in noncubic crystals is illustrated, and thereby, the general equivalence of the GBD and coincidence structural unit models is clearly demonstrated. Author (GRA)

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N77-15888 Minnesota Univ., Minneapolis.
DIRECT CONTACT HEAT TRANSFER WITH CHANGE OF PHASE AT HIGH PRESSURE IN A STEAM-WATER SYSTEM Ph.D. Thesis
Gregory George Brucker 1976 176 p
Avail: Univ. Microfilms Order No. 76-27877

An average heat transfer coefficient based on the heat content of the bubble, half the initial area, the time to collapse, and the temperature difference of subcooling were found to vary from 6,000 to 25,000 W/sq m C, for all the operating conditions of the experiments. The above values are of the same magnitude as those calculated for a rigid, three millimeter sphere moving at the average velocity of the bubble. The instantaneous heat transfer coefficients were found to decrease with time for the lower pressure levels and to increase with time for the higher pressure levels. At the highest pressure level, the behavior of the instantaneous coefficient with time was similar to that of a bubble whose shape was spherical during the entire collapse. The deviations of the instantaneous coefficients from the above mentioned averages were within plus or minus 50 percent.
Dissert. Abstr.

N77-15889 Washington State Univ., Pullman.
THE STOCHASTIC APPROACH TO QUANTUM MECHANICS Ph.D. Thesis
William Joseph Lehr 1976 106 p
Avail: Univ. Microfilms Order No. 76-27742

A critical review of the Copenhagen interpretation of quantum mechanics shows that, as a model for the individual system, it suffers from severe conceptual difficulties, particularly with regard to the problem of measurement. A promising alternative interpretation is the stochastic approach, which presumes that every physical system is continually interacting with a hidden thermostat. This thermostat has a randomizing effect on the position variable and necessitates a probabilistic description of the path of the system. If the concepts of both backward and forward diffusion are utilized, it is possible to construct a straightforward stochastic rule for computing the mean value of any observable which has a classical operational definition. Estimates based upon the rule agree with standard quantum predictions up to second order in momentum but disagree in higher order terms. Dissert. Abstr.

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N77-15890# Defense Systems Management School, Fort Belvoir, Va.
NAVY AIRBORNE TACTICAL SOFTWARE MANAGEMENT POLICY: REVIEW AND EVALUATION
Dale C. Dunham Nov. 1975 35 p refs
(AD-A027023) Avail: NTIS HC A03/MF A01 CSCL 09/2

The purposes of this report are to review current and proposed policies pertaining to management of airborne tactical software in the Navy and then present some views on the effectiveness of these policies. Views on the effectiveness of the current and proposed policies on management of airborne software were obtained by interviewing NAVAIRSYSCOM personal. In general, it was found that the current and proposed policies on management of airborne tactical software were considered adequate, that airborne tactical software is treated as a configuration item, and that in-house organic support for airborne tactical software is considered essential after the host aircraft system is in full production to ensure maintenance as the software after the host aircraft system production has been completed. GRA

N77-15891# Dikewood Industries, Inc., Albuquerque, N. Mex.
A SURVEY OF EXISTING MANAGEMENT INFORMATION SYSTEMS. SOFTWARE AND HARDWARE OPTIONS Final Report
B. G. VanBlaricum and C. A. Luff Kirtland AFB, N. Mex. AFSWC Jun. 1976 92 p refs
(Contract F29601-74-C-0022)
(AD-A027046; AFSWC-TR-75-10) Avail: NTIS HC A05/MF A01 CSCL 09/2

A survey of available management information systems and subsystems to determine appropriate packages for TESPO's needs was conducted throughout the various technical environments. The survey was confined first to automated, and later, to all MIS portions that could be applied to project management, to automated network analyses, and to appropriate subsystems. Twenty systems are reviewed in detail for software, hardware and procedural constraints. A complete economic and overall technical evaluation is assessed each of the reviewed systems. Preferred alternatives, both economic and technical, are presented with guidelines for the next efforts. The survey report will be updated by ongoing contact with the various MIS communities. Also, the preliminary design and development of TESPO's own Management Information System is outlined briefly.
Author (GRA)

N77-15892# Stanford Research Inst., Menlo Park, Calif.
DEVELOPMENT OF AUTOMATED AIDS FOR DECISION ANALYSIS Final Report
Allen C. Miller, Miley W. Merkhofer, Ronald A. Howard, James E. Matheson, and Thomas R. Rice May 1976 215 p refs
(Contract MDA903-74-C-0240; DARPA Order 2742; SRI Proj. 3309)
(AD-A026379) Avail: NTIS HC A10/MF A01 CSCL 09/2

This report summarizes research undertaken to initiate development of a system of automated decision aids. The purpose of these aids is to facilitate the application of decision analysis to major decisions within the Department of Defense. The report contains: (1) a characterization of the spectrum of decision situations that are encountered in practice and an exploration of the implications of these characteristics for automated decision aids; (2) a description of the types of decision models available for analyzing various decision situations; (3) a description of the process by which decision models are constructed; and (4) an identification of several modeling concepts that provide a basis for designing and constructing a pilot-level system of automated decision aids. Author (GRA)

N77-15893# Comptroller General of the United States, Washington, D.C. Resources and Economic Development Div.
NEED FOR BETTER MANAGEMENT AND CONTROL OVER SCIENTIFIC EQUIPMENT (REPORT TO THE CONGRESS)
3 May 1976 24 p Prepared in cooperation with EPA, Washington, D.C.
(PB-257289/9; RED-76-100; B-166506-760503) Avail: NTIS HC A02/MF A01 CSCL 14B

The need for the Environmental Protection Agency to improve its management of scientific laboratory equipment is outlined.

The review was made because in earlier review work at Environmental Protection Agency laboratories need for improvement in property records was found. Coordination should be improved between laboratories before new equipment is purchased. GRA

N77-15894# Arizona State Univ., Tempe.
EVALUATION OF A CONTINGENCY JOB DESIGN MODEL IN AN INFORMATION TECHNOLOGY ENVIRONMENT
Philip Edward Lowry May 1976 177 p refs
(AD-A026943) Avail: NTIS HC A08/MF A01 CSCL 05/9

This study evaluated a contingency job design model in an information technology environment. The study involved employees (military and civilian) of two United States Army organizations which develop and operate ADP programs. The objective was to determine whether the design model predicts organization behavior in certain ADP jobs. The study examined the relationship between certain job characteristics (task significance, task identity, skill variety, autonomy, and feedback from the job) and on job behavior as represented by internal motivation, general satisfaction, performance, turnover, and absenteeism. Also, the study examined the extent to which growth needs and work values moderated the relationship betwen job characteristics and job behavior. Results of the study indicate that internal motivation, general satisfaction, and performance of ADP personnel are affected by job characteristics. While growth needs and work values do moderate the relationship, the moderating value is relatively weak. Age, sex, and education demonstrated insignificant or weak influence on job behavior. The study was relevant to the United States Army. Nearly eleven thousand Army employees are in ADP jobs. The ultimate result of improved job design can be increased satisfaction and higher quality performance. Author (GRA)

N77-15895*# Defense Systems Management School, Fort Belvoir, Va.
DOD/NASA SUPPORT OPERATIONS MANAGEMENT INTERFACE
Thomas E. Timothy Nov. 1975 56 p refs Sponsored in part by NASA
(NASA-CR-149203; AD-A027276) Avail: NTIS HC A04/MF A01 CSCL 05/1

The purpose of this study was to investigate the manner in which support operations have been provided from DOD resources to the NASA for manned space flight endeavors. Of particular interest was the investigation of the new Space Shuttle program. The approach used was to examine the historical documents of manned space flight through the recently concluded Apollo Soyuz mission. This investigation developed the extremely successful way in which support operations have been managed by the DOD. Additional research was carried into the Space Shuttle documentation for an insight into how this same type support might be supplied for that mission. This study points out how a well defined, operationally tested management interface is being allowed to deteriorate and perhaps be discarded for a program that appears to need it desperately. GRA

N77-14985# National Research Council of Canada, Ottawa (Ontario).
CANADIAN RESEARCH AND DEVELOPMENT POLICIES
J. D. Keys *In* AGARD 11th AGARD Ann. Meeting Feb. 1976 p 19-21 (For primary document see N77-14982 06-01) Avail: NTIS HC A04/MF A01

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software*.

N77-15896# Regional Planning Council,
DEVELOPING GEOGRAPHIC-BASED INFORMATION FILES: A BIBLIOGRAPHIC ESSAY Final Report
Jul. 1976 24 p
(Grant HUD-P-1110)
(PB-257668/4) Avail: NTIS HC A02/MF A01 CSCL 05B

A range of materials dealing with the design and implementation of geographic-based information files is presented. Readings range from the theory of system development to the techniques of using remotely sensed data in the planning process. GRA

N77-15897# National Library of Medicine, Bethesda, Md. Bibliographic Services Div.
MEDICAL SUBJECT HEADINGS: TREE ANNOTATIONS 1977. MEDLARS INDEXING INSTRUCTIONS
Thelma Charen 1976 118 p
(PB-257939/9; NLM-MED-76-06) Avail: NTIS HC A06/MF A01 CSCL 05B

The manual is designed for medical indexers and searchers. It has a two-fold purpose: first, to give a general statement on the approach an indexer or searcher should pursue to a given tree, and second, to advise him of special features within that tree that he should be aware of before indexing or searching. GRA

N77-15898# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Labs.
VERY LARGE PLANNER-TYPE DATA BASES
Drew V. McDermott Sep. 1975 54 p refs
(Contract N00014-75-C-0643)
(AD-A026370; AI-M-339) Avail: NTIS HC A04/MF A01 CSCL 06/4

This paper describes the implementation of a typical data-base manager for an AI language like Planner, Conniver, or QA4, and some proposed extensions for applications involving greater quantities of data than usual. The extensions are concerned with data bases involving several active and potentially active sub-data bases, or contexts. The major mechanisms discussed are the use of contexts as packets of data with free variables and indexing data according to the contexts they appear in. The paper also defends the Planner approach to data representation against some more recent proposals. Author (GRA)

N77-15899# British Library Lending Div., Boston Spa (England).
CORRELATED STRUCTURE: TEXT SEARCHING FOR CHEMICAL INFORMATION
J. Powell, J. F. B. Rowland, and M. A. Veal Jul. 1976 124 p refs
(BLL-BLRD-5292) Avail: British Library Lending Div., Boston Spa, Engl.

The Chemical Abstracts Integrated Subject File, a machine-readable data base corresponding to the six-monthly subject index of Chemical Abstracts, was used for an experiment in structure-text searching. One six-month file was used in the experiment. This was first divided into a nomenclature file, containing the systematic chemical names of all the compounds in the index and a text file, containing all other information on the file. For each of a collection of test questions, a nomenclature profile to search for the required substructures and a text profile to search for the required concepts were written. The nomenclature profiles were then searched against the nomenclature file. The resulting list of relevant compounds was then passed across to the text file, where the corresponding text profiles were used to refine the results; the compounds retrieved in the nomenclature search were linked logically to the concepts required in the text search, and only those documents satisfying both criteria were counted as hits. Author

N77-15900# British Library Lending Div., Boston Spa (England).
A PRELIMINARY STUDY OF DATA HANDLING TECHNIQUES IN THE UNITED KINGDOM, VOLUME 1 Final Report, Nov. 1975 - Apr. 1976
A. Robson Apr. 1976 187 p refs
(BLL-BLRD-5296-Vol-1) Avail: British Library Lending Div., Boston Spa, Engl.

The data handling techniques of a small number of United Kingdom data centers were examined in detail and a methodology was demonstrated for describing them. Comparisons were made between the centers in an effort to identify the different data handling techniques and processes. Collaboration between centers on data collection seems not to be feasible except in the very

limited areas where the interests of the centers overlap. Collaboration may be possible to develop new techniques such as the use of OCR for data input. Techniques for data manipulation may have applications outside the areas with which the data centers themselves are concerned. Author

N77-15901# British Library Lending Div., Boston Spa (England).
REPORT OF A WORKSHOP ON TEACHING ON-LINE BIBLIOGRAPHIC SEARCHING
E. M. Keen and L. A. Tedd Jul. 1976 13 p Workshop held at Aberystwyth, Engl., 12-14 Apr. 1976
(BLL-BLRD-5286) Avail: British Library Lending Div., Boston Spa, Engl.

The workshop examined in detail the technical problems and diverse experience of the ten or so library schools which are, or have been, engaged in research into the teaching of on-line bibliographic searching. The organization of the workshop is covered and some of the documentation that was produced by participants is included. Broad topics were allocated for each session which included: (1) using DIALOG, (2) using other big systems such as SDC or medline, (3) teaching techniques, and (4) use of local systems. Author

N77-15902# British Library Lending Div., Boston Spa (England).
AN INDEXING AND RETRIEVAL SERVICE FOR STATISTICS USERS: DESIGN CONSIDERATIONS FOR A COMPUTER-BASED SYSTEM
G. E. Hamilton May 1976 143 p refs
(BLL-BLRD-5298) Avail: British Library Lending Div., Boston Spa, Engl.

An account of the work done during the second stage of the STIR investigation, carried out at Loughborough University of Technology is presented. The study team's final conclusion is that a computer-based indexing and retrieval system for published sources of United Kingdom statistics is technically feasible. Some cost estimates for developing an operational system and the techniques for operating it were developed. These estimates show there is a reasonable prospect of recovering at least a substantial part of the operational costs of the system through the sale of its products and services. The proposed system would offer two main services. A printed index under broad subject headings representing the principal subjects and concepts which occur in statistical tables would be provided. Index entries would include brief citations to sources, with essential details for identifying and locating source tables in publication. A reference retrieval service, based on very specific indexing of tables would provide references to statistical tables following a search on a machine-readable data base. Author

N77-15903# British Library Lending Div., Boston Spa (England).
TRENDS IN THE EDUCATION OF USERS OF LIBRARIES AND INFORMATION SERVICES IN THE USA
D. Michael Brittain (Loughborough Univ., Engl.) and Ann Irving (Loughborough Univ., Engl.) Apr. 1976 99 p refs
(BLL-BLRD-5297) Avail: British Library Lending Div., Boston Spa, Engl.

A state-of-the-art review of current practices and trends in the education of users of library and information services in universities in the United States is presented. It was based on a postal enquiry made to 80 universities during the summer of 1975. The report also covers the work in this field supported by the Council on Library Resources. A model of library instruction is included, and the report is indexed. Author

N77-15904# British Library Lending Div., Boston Spa (England).
AUTOMATIC AIDS TO PROFILE CONSTRUCTION. EXPANSION OF SEARCH TERMS BY THESAURUS
Lynn Evans and Angela M. Gould Jan. 1976 111 p refs
(BLL-BLRD-5274; ISBN-0-85296-433-1) Avail: British Library Lending Div., Boston Spa, Engl.

The use of the INSPEC thesaurus as a source of terms for automatically generating SDI profiles was evaluated experimentally. Thirty university based research workers provided natural language statements of their subject interests from which common words were removed, the resulting list being used as a base profile version. Three further profile versions were derived automatically from the basic list of terms by utilizing the thesaurus structure. Those words in the basic list which matched, completely or partly, terms in the thesaurus were supplemented successively by the addition of synonyms, narrower terms, and selected related terms. When searched against two document collections the retrieval performances of the four automatic profile versions were not usefully different and, against expectations, the general trend was for poorer recall with each expansion. Author

N77-15905# British Library Lending Div., Boston Spa (England).
THE ROLE OF A COMPUTER RETRIEVAL SYSTEM IN INFORMATION GATHERING BY PSYCHOLOGISTS: A PILOT SURVEY Final Report, Dec. 1975 - Feb. 1976
R. E. Rawles (Univ. Coll., London) Apr. 1976 105 p refs
(BLL-BLRD-5261) Avail: British Library Lending Div., Boston Spa, Engl.

A sample of 15 university lecturers in psychology, from three different colleges, took part in a structured interview based on a 90 item questionnaire to elucidate the ways in which they dealt with psychological literature. They were then invited to make use of a computerized information retrieval system, in which the main file was for Psychological Abstracts, as frequently as they required over a period of three months from the interview. Those who used the system were given a second interview about two weeks after their first visit. Answers to a 15 item questionnaire were obtained. These showed that the majority of users valued highly the information they had retrieved and that about half saw the system as likely to produce a change in the way they gathered information - better library use, increased use of inter-library loans and a decreased use of bibliographic tools. All users made suggestions for making the system more client effective. Author

N77-15906# British Library Lending Div., Boston Spa (England).
TRENDS IN SCIENTIFIC AND TECHNICAL PRIMARY JOURNAL PUBLISHING IN THE USA
Peter W. Lea Mar. 1976 33 p refs
(BLL-BLRD-5272; ISBN-0-85350-138-6) Avail: British Library Lending Div., Boston Spa, Engl.: £2.50

Current ideas on scientific and technical primary journal publishing were discussed. Trends and innovations were identified. Discussions were held with primary publishers, both commercial and institutional, secondary publishers and various other representatives. The main trends identified include the growth of computer photocomposition, Federal Government involvement in research relating to electronic alternatives, and various activities in microform publishing. Two NSF projects are summarized; one is a study of the relationship between journals and their users, the other is a guide to innovations in scientific and technical publishing. Recommendations are made and the need for international cooperation is emphasized. Author

N77-15907# British Library Lending Div., Boston Spa (England).
COMMUNICATION NETWORKS IN R AND D: A CONTRIBUTION TO METHODOLOGY AND SOME RESULTS IN A PARTICULAR LABORATORY
E. Ritchie and A. Hindle May 1976 69 p refs
(BLL-BLRD-5291) Avail: British Library Lending Div., Boston Spa, Engl.

Methods of identifying and analyzing the patterns of technical communication within the laboratory were developed. Experimental tools were designed which can be used with relatively little disruptive effect on the laboratory. This method makes experimentation feasible to discover directly the response of technical communication patterns to managerial actions. This methodology can also be used for exploring these inter-relationships by monitoring communication patterns and managerial actions over time. In this way, the degree of management control over technical communication can be established. In identifying and analyzing the patterns of technical communication in the laboratory the main contribution was in the application of path methods. The data concerning communication were obtained from a detailed questionnaire survey of the laboratory personnel. Each node in the resulting networks is a scientist and each element represents the frequency of communication (of a pre-defined type) between any pair of scientists. Author

N77-15908# Advisory Group for Aerospace Research and Development, Paris (France).

METHODOLOGY OF LARGE DYNAMIC FILES
A. K. Gillis (Harris Corp., Melbourne, Fla.) Dec. 1976 24 p (AGARD-R-649; ISBN-92-835-1233-3) Avail: NTIS HC A02/MF A01

Data collection, conversion, storage, and retrieval trends were examined. Entity formatting and element transformation were discussed as well as digital storage alternatives and storage hierarchy. Data base management, management systems software, and implementation considerations concerning data retrieval were investigated. S.M.

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N77-15909# Brown Univ., Providence, R. I.
THE RELATIONSHIP OF TECHNOLOGICAL CHANGE AND THE DEMAND FOR AND SUPPLY OF RAW MATERIALS. EXECUTIVE SUMMARY Final Report
Ryuzo Sato and R. V. Ramachandran Mar. 1976 22 p refs (Grant NSF DA-44118)
(PB-256031/6; NSF/RDA-74/13/1) Avail: NTIS HC A02/MF A01; also available in set of 3 reports as PB-256030-12 PC $12.00/MF $4.75 CSCL 05C

A literature survey which assesses the usefulness and limitations of existing methodologies for determining the relationship of technological change and the demand for and supply of raw materials is summarized. Data requirements and data availability for the use of the various analytical techniques were discussed. The techniques discussed are input-output analysis, indices of partial and total productivity, and multifactor production functions. GRA

N77-15910# Brown Univ., Providence, R. I.
THE RELATIONSHIP OF TECHNOLOGICAL CHANGE AND THE DEMAND FOR AND SUPPLY OF RAW MATERIALS. SECTION 2: ANALYTICAL REPORT Final Report
Ryuzo Sato and R. V. Ramachandran Mar. 1976 96 p refs (Grant NSF DA-44118)
(PB-256032/4; NSF/RDA-74/13/2) Avail: NTIS HC A05/MF A01; also available in set of 3 reports as PB-256030-SET, PC $12.00/MF $4.75 CSCL 05C

For abstract, see N77-15909.

N77-15911# Brown Univ., Providence, R. I.
THE RELATIONSHIP OF TECHNOLOGICAL CHANGE AND THE DEMAND FOR AND SUPPLY OF RAW MATERIALS. SECTION 3: CLASSIFICATION OF ABSTRACTS Final Report
Ryuzo Sato and R. V. Ramachandran Mar. 1976 75 p refs (Grant NSF DA-44118)
(PB-256033/2; NSF/RDA-74/13/3) Avail: NTIS HC A04/MF A01; also available in set of 3 reports as PB-256030-SET, PC $12.00/MF $4.75 CSCL 05C

Abstracts are presented on the techniques that are used to study the relationship of technological change and the demand for and supply of raw materials. Abstracts of articles on the measurement of technological change, on indices of factor productivity, on input-output analysis, and on production function analysis, particularly of steam electric power generation and on agriculture were considered. GRA

84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

No abstracts in this category.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety*, *16 Space Transportation*, and *44 Energy Production and Conversion*.

N77-15912 Maryland Univ., College Park.
DEVELOPMENT OF A METHODOLOGY FOR PREDICTING PUBLIC TRANSPORTATION NEEDS FOR SMALL CITIES Ph.D. Thesis
Himmat Singh Chadda 1976 264 p
Avail: Univ. Microfilms Order No. 76-27369

A simple and easy-to-apply methodology for predicting public transportation needs for small cities (less than 50,000 population) was developed. The characteristics of small cities as compared to larger urban areas were synthesized and the need and justification for public transit in small cities was evaluated. The use of secondary data, readily available from sources such as the Bureau of the Census, was considered a more practical and economical approach for small city managements. A case study approach for the collection of data and the study of characteristics of existing transit systems in selected cities was utilized. The predictor variables used in the development of the demand prediction model were selected using statistical procedures including: correlation, principal component, and factor analyses; and considerable subjective reasoning for the logic of the proposed relationships between the variables. Dissert. Abstr.

N77-15913# Washington State Univ., Pullman. College of Agriculture.
ECONOMIC COSTS OF CONTROLLING WATER QUALITY THROUGH MANAGEMENT OF IRRIGATION RETURN FLOWS
George H. Pfieffer and Norman K. Whittlesey Aug. 1976 67 p refs
(Contract DI-14-31-0001-5125)
(PB-257517/3; W76-12218; OWRT-B-059-WASH(2)) Avail: NTIS HC A04/MF A01 CSCL 02C

The economic and social costs of alternative policies that could be used to control water quality through management of irrigation return flows were focused on. Three environmental quality parameters associated with irrigated agriculture were singled out for analysis. These parameters were river water nitrogen concentration, river water temperature and loss of sediment from irrigated farms. A dual simulation and linear programming model was used as the vehicle of analysis. Policies considered for analysis included taxing water and nitrogen inputs, reducing water rights, and improved management techniques. GRA

N77-15914# North Carolina State Univ., Raleigh.
OVERLAND FLOW PRETREATMENT OF WASTEWATER
Michael R. Overcash, Donald M. Covil, J. Wendell Gilliam, Philip W. Westerman, and Frank J. Humenik Jun. 1976 156 p refs (Contract DI-14-31-0001-4113)
(PB-257143/8; UNC-WRRI-76-117; W76-11775; OWRT-B-067-NC(2)) Avail: NTIS HC A08/MF A01 CSCL 02C

Overland flow (OLF) as a pretreatment process for wastewater was studied in a three-part approach: (1) an assessment of established treatment mechanisms and literature data to rank the potential uses of the OLF process for municipal, industrial, and agricultural wastes according to advantageous usage in the Southeast; (2) experimental research into nitrogen transformations occurring in OLF for poultry manure; and (3) the scale-up application of research and project results to a farm animal production level. With regard to municipal wastes, OLF was estimated to be most advantageous when used to replace secondary treatment followed by direct stream discharge or by advanced treatment. GRA

N77-15915# Environmental Protection Agency, Washington, D.C. Municipal Construction Div.

AN ANALYSIS OF CONSTRUCTION COST EXPERIENCE FOR WASTEWATER TREATMENT PLANTS
Feb. 1976 56 p refs
(PB-257455/6; EPA-430/9-76-002; EPA/MCD-22) Avail: NTIS HC A04/MF A01 CSCL 13B

An analysis of wastewater treatment plant construction cost experience, an evaluation of the cost estimating system, and the development of treatment plant cost curves are addressed. A data base consisting of descriptions and bid and grant eligible cost data for over 150 treatment plants constructed in the last four years was obtained from EPA Regional Offices and used in the analysis. GRA

N77-15916# Environmental Protection Agency, Washington, D.C. Municipal Construction Div.
DISINFECTION OF WASTEWATER. TASK FORCE REPORT
Mar. 1976 67 p refs
(PB-257449/9; EPA-430/9-75-012; EPA/MCD-21) Avail: NTIS HC A04/MF A01 CSCL 13B

A task force report was prepared to provide a compilation of the existing technical and scientific data related to the issues raised by wastewater disinfection. A summary of the agency's ongoing research and development program in the area of wastewater disinfection and alternate means of disinfection was presented. Public health effects and toxic effects on the aquatic environment were considered. GRA

N77-15917# Hittman Associates, Inc., Columbia, Md.
SURVEY OF USER ACCEPTANCE OF THE SOLID WASTE REMOVAL SYSTEMS AT OPERATION BREAKTHROUGH SITES
Martin V. Bloom Dec. 1976 315 p Sponsored in part by HUD Prepared in cooperation with Applied Management Sci., Inc., Silver Spring, Md.
(Contract EPA-68-03-0094)
(PB-257474/7; EPA-600/2-76-229) Avail: NTIS HC A14/MF A01 CSCL 13B

The solid waste disposal characteristics and resident attitudes are discussed about solid waste disposal methods at eight Operation Breakthrough sites. The data were obtained through on-site interviews of 1,023 households and eight representatives of site management. The survey was conducted during the period of January through March 31, 1975. The report includes resident and management perceptions of the adequacy of trash storage and collection facilities and services, waste storage requirements and practices, and of the suitability of the system to the environment. The data do not constitute a technical evaluation of the solid waste management system at each facility, and no on-site inspections of facilities were conducted to verify conditions reported by the residents. GRA

N77-15918# Metropolitan Transportation Commission, Berkeley, Calif.
ENVIRONMENTAL IMPACTS OF BART INTERIM SERVICE FINDINGS, REPORT ON PHASE 1
Jan. 1976 137 p refs Sponsored in part by HUD Prepared in cooperation with Gruen Assoc., Los Angeles; and DeLeuw, Cather and Co., San Francisco
(Contract DOT-OS-30176)
(PB-257498/6; DOT-BIP-FR-2-4-75) Avail: NTIS HC A07/MF A01 CSCL 13B

During this phase, the project has concentrated on BART's immediate effects on the physical dimensions of the urban ecosystem. It has examined what aspects of the environment have been affected by BART, what physical and operational characteristics of BART cause the impact where the impacts are occurring, what the demographic characteristics are of those who are affected, and how lessons from BART can be used to guide decision-making on urban transportation and development in the bay area and elsewhere. GRA

N77-15919# Midwest Research Inst., Kansas City, Mo.
FINE SHREDDING OF MUNICIPAL SOLID WASTE Final Report, Jun. 1975 - Jun. 1976
K. P. Ananth and J. Shum Jul. 1976 71 p refs
(Contract EPA-68-02-1324)
(PB-257105/7; EPA-600/2-76-208) Avail: NTIS HC A04/MF A01 CSCL 13B

Equipment used for municipal solid waste (MSW) size reduction and its performance and cost are discussed. Of the 11 basic equipment types used for shredding MSW, only hammermills and grinders find wide application. An evaluation of available hammermill and grinder performance data indicates that: their specific energy consumption is indpendent of throughput for the same product size distributions and feed characteristics (power, however, is a function of throughput); higher shaft speeds produce finer size distributions and require more energy for the same throughputs; smaller grate spacings (exit clearances) produce finer particles; and for constant feed and shredder operating conditions, specific energy consumption is a minimum at 30-40% refuse moisture content. GRA

N77-15920# Transportation Systems Center, Cambridge, Mass.
IN-SERVICE PERFORMANCE AND COSTS OF METHODS FOR CONTROL OF URBAN RAIL SYSTEM NOISE, EXPERIMENTAL DESIGN Interim Report, Jul. 1975 - Mar. 1976
Michael C. Holowaty (Deleuw, Cather and Co., Philadelphia, Pa.), Hugh J. Saurenman (Wilson, Ihrig and Associates, Inc., Oakland, Calif.), and Stanley M. Rosen (Wilson, Ihrig and Associates, Inc., Oakland, Calif.) May 1976 108 p
(Contract DOT-TSC-1053)
(PB-257200/6; DOT-TSC-UMTA-76-11; UMTA-MA-06-0025-76-4) Avail: NTIS HC A06/MF A01 CSCL 13B

An experimental design for a project to evaluate four techniques for reducing wheel-rail noise on urban rail transit systems was presented: (1) resilient wheels (2) damped wheels, (3) wheel truing, and (4) rail grinding. The design gives data requirements for acoustic testing on the Southeastern Pennsylvania Transportation Authority Market-Frankford Line, as well as requirements for collection of non-acoustic data covering all United States rapid transit systems. It prescribes methods for analysis of the data, means for drawing inferences to answer the questions posed, and formats for presentation. GRA

N77-15921# Camp, Dresser and McKee, Inc., Boston, Mass.
DIRECT ENVIRONMENTAL FACTORS AT MUNICIPAL WASTEWATER TREATMENT WORKS
R. Ernest Leffel Jan. 1976 114 p refs
(Contract EPA-68-01-0324)
(PB-257456/4; EPA-430/9-76-003; EPA/MCD-20) Avail: NTIS HC A06/MF A01

The methodology and reference information are discussed for Federal guidelines and the designers of publicly owned wastewater treatment works in compliance with the Federal Water Pollution Control Act Amendment of 1972 (P.L. 92-500). To assist in obtaining maximum flexibility and economy in the design, construction, operation, and maintenance of wastewater treatment works, while ensuring the required level of environmental compatibility, relevant considerations are presented. Municipal wastewater treatment works include treatment plants, pumping stations, separation structures, interceptors, force mains, certain collection systems, and outfalls. GRA

N77-15922# National Bureau of Standards, Washington, D.C. Inst. for Computer Sciences and Technology.
AUTOMATION TECHNOLOGY APPLIED TO PUBLIC SERVICE Final Report
Edwin G. Johnson, ed. Sep. 1976 90 p Conf. held at Gaithersburg, Md., 21-22 May 1974 Sponsored in part by NSF; GAO; and Urban Inst., Washington, D. C.
(PB-257468/9; NBS-SP-448; LC-76-608251) Avail: NTIS HC A05/MF A01 CSCL 05A

The use of automation technology was explored as a means of increasing the efficiency of government in providing higher quality public services at lower cost. The political, social and economic aspects involved in managing the public service applications of automation were investigated. Potential uses of automation technology discussed include automating operations in environments hazardous to safety and health of people, such as fire fighting, and the automation of services that are tedious, boring or demeaning for people to do. Potential applications of automation technology in public service include garbage collection, aids to the handicapped, water treatment process control, and adaptive computerized regulation of traffic in urban areas. Author

N77-15923# National Bureau of Standards, Washington, D.C.
INTEGRATING COMMUNITY UTILITIES FOR RESOURCE CONSERVATION Final Report
John R. Schaefgen 1976 9 p refs Presented at 3d Natl. Conf. on Complete Water Reuse: Symbiosis as a Means of Abatement for Multi-Media Pollution, Cincinnati, 27-30 Jun. 1976 p 53-59 Sponsored in part by HUD
(PB-256898/8) Avail: NTIS HC A02/MF A01 CSCL 10A

A Modular Integrated Utility System (MIUS) provides the utility services of electrical power, space heating and cooling, potable water heating, solid waste processing, sanitary sewage treatment, potable water treatment, and the site distribution, collection, and disposal functions attendant thereto. MIUS facilities are constructed on a community scale to achieve the maximum symbiotic effects from process integration. The MIUS approach to utility services can conserve energy, reduce environmental degradation, and permit greater flexibility in intensive land development at a competitive cost. This report briefly discusses the characteristics and benefits of MIUS facilities. GRA

N77-15924# Battelle Columbus Labs., Ohio.
THE MICROCOMPUTER: TECHNOLOGY INNOVATION AND TRANSFER Working Paper, Sep. - Nov. 1975
Herbert S. Kleiman 16 Dec. 1975 41 p
(Contract MDA903-75-C-0131; ARPA Order 2857)
(AD-A026970) Avail: NTIS HC A03/MF A01 CSCL 05/3

A research program to better understand technology transfer within the Soviet Union, whether that technology is obtained from outside or internal sources, is currently underway. Ultimately, this program should assist U.S. decisionmakers in analyzing a variety of related questions, including those associated with aspects of export embargo controls. GRA

N77-15925# Weiner and Associates, Denver, Colo.
ASPEN METRO SANITATION DISTRICT. SNOWMASS WATER AND SANITATION DISTRICT. 201 WASTEWATER FACILITIES PLANS
Aug. 1976 147 p refs Sponsored by EPA
(PB-257589/2) Avail: NTIS HC A07/MF A01 CSCL 13B

The Region 8 Administrator of the U.S. Environmental Protection Agency intends to provide federal matching funds for regional wastewater treatment in the combined Aspen and Snowmass Resort study areas within Colorado, through the authority of the Water Pollution Control Act (as amended, 1972). The purpose of this draft Environmental Impact Statement (EIS), required of federal agencies by the National Environmental Policy Act (NEPA, 1969) is to notify governmental agencies and the public at large of this impending project with potential environmental ramifications. GRA

N77-15926# Real Estate Research Corp., Chicago, Ill.
THE COSTS OF SPRAWL: CASE STUDIES AND FURTHER RESEARCH Final Report
Oct. 1975 251 p Sponsored in part by Council on Environ. Quality
(Contract EQ4AC039)
(PB-257738/5) Avail: NTIS HC A12/MF A01 CSCL 13B

Environmental and economic effects of alternative development patterns are discussed. Five case study suburbs: Arlington Heights, Ill.; Park Forest South, Ill.; Amherst, N.Y.; Reston, Va.; and West Springfield, Va. were investigated. GRA

N77-15927# TRW, Inc., Redondo Beach, Calif.
IMPACTS OF BART ON AIR QUALITY INTERIM SERVICE FINDINGS
Mar. 1976 122 p refs Sponsored in part by HUD and Metropolitan Transportation Comm., Berkeley Prepared in cooperation with Gruen Assoc., Inc., Los Angeles, Calif. and De Leuw, Cather and Co., San Francisco
(Contract DOT-OS-30176)
(PB-257511/6; DOT-BIP-WP-20-4-76) Avail: NTIS HC A06/MF A01 CSCL 13B

Findings and methodologies developed during a study of BART's atmospheric impacts are reported. The atmospheric environment for the purpose of this study is described by the impact catergories of local and regional air quality and microclimate. Assessment included effects on regional air pollutant emissions (CO, RHC, NOx), station area carbon monoxide (CO) emissions, and changes in wind direction and velocity. GRA

N77-15928# Gruen Associates, Los Angeles, Calif.
IMPACTS OF BART ON VISUAL QUALITY Interim Service Findings.
Mar. 1976 69 p refs Sponsored in part by HUD Prepared for Metropol. Transportation Comm., Berkeley, Calif.
(Contract DOT-OS-30176)
(PB-257509/0; DOT-BIP-TM-18-4-76) Avail: NTIS HC A04/MF A01 CSCL 13B

Night-time illumination study was carried out to determine what effect direct visible light sources, such as train lights, station lighting and parking lot illumination, have on nightime visual environments. The shadow study evaluated the effects of shadowing on areas adjacent to elevated and at grade guideways and stations. GRA

N77-15929# Gruen Associates, Los Angeles, Calif.
IMPACTS OF BART ON THE SOCIAL ENVIRONMENT Interim Service Findings.
Mar. 1976 136 p refs Sponsored in part by HUD Prepared for Metropol. Transportation Comm., Berkeley, Calif. Prepared in cooperation with DeLeuw, Cather and Co., San Francisco
(Contract DOT-OS-30176)
(PB-257510/8; DOT-BIP-TM-19-4-76) Avail: NTIS HC A07/MF A01 CSCL 13B

Four impact categories were used to organize this assessment: barriers, safety (against bodily harm), security (against threats to persons or property), visual exposure. The effort included the gathering of complementary types of data, widespread interviews with community officials, consultations with knowledgeable professionals, and direct observation in specific locations. GRA

N77-15930# Wisconsin Univ., Madison. Engineering Experiment Station.
INCREASED FUEL ECONOMY IN TRANSPORTATION SYSTEMS BY USE OF ENERGY MANAGEMENT - SECOND YEAR'S PROGRAM Final Report, Dec. 1975
N. H. Beachley and A. A. Frank Dec. 1975 239 p
(Contract DOT-OS-30112)
(PB-257177/6; DOT-TST-76-57) Avail: NTIS HC A11/MF A01 CSCL 13F

Design and analytic evaluation of experimental vehicles equipped with a flywheel energy management powerplant were considered. An energy storage flywheel was employed to permit more efficient fuel utilization. Modeling techniques that permit the accurate prediction of transient emissions from an automobile over any driving cycle, and the fuel-saving potential of relatively straightforward changes to transmissions and drivetrain systems were explored. GRA

N77-15931# Gillette Research Inst., Inc., Rockville, Md.
USER'S MANUAL FOR SULFATE WASTE IN ROAD CONSTRUCTION Final Report
Lloyd M. Smith (Va. Univ.) and H. Gordon Larew Dec. 1975 32 p refs
(Contract DOT-FH-11-8122)
(PB-257176/8; FHWA-RD-76-11) Avail: NTIS HC A03/MF A01 CSCL 13C

Results of laboratory tests on compacted specimens composed of fly ash waste sulfate, lime and water are summarized. These tests include: compressive strength, tensile strength, California Bearing Ratio, permeability, freeze-haw resistance and wet-dry stability. While the mixtures were found to have acceptable strength properties, high California Bearing Ratio and low permeability, the durability properties were judged to be marginal. GRA

N77-15932# Reebie (Robert) and Associates, Inc., Greenwich, Conn.
NATIONAL INTERMODAL NETWORK FEASIBILITY STUDY. PART 1: VOLUMES 1-4 Final Report
R. S. Reebie, D. P. Ainsworth, C. J. Liba, J. B. Riker, M. J. Keale, and C. E. Urba May 1976 420 p refs 4 Vol.
(Contract DOT-FR-20065)
(PB-258196/5; FRA/OPPD-76/2.1-Pt-1) Avail: NTIS HC A18/MF A01 CSCL 13F

Volume 2 describes the current environment in which various land transportation modes compete for the movement of containerizable freight. Volume 3 presents the procedures and findings of the study phases that developed a network operating plan. It compares the service and economic capabilities of an improved intermodal network with similar capabilities of efficient operations of competing modes. It describes network operations that were developed. Volume 4 assesses the feasiblity of a nationwide intermodal network by reviewing the operating implications developed earlier. GRA

N77-15933# Peat, Marwick, Mitchell and Co., Washington, D.C.
NATIONAL INTERMODAL NETWORK FEASIBILITY STUDY. PART 2: APPENDICES 1-4 Final Report
R. S. Reebie, D. P. Ainsworth, C. J. Liba, J. B. Riker, M. J. Keale, C. E. Urba, D. A. Isacowitc, and M. O. Laughlin May 1976 357 p refs Prepared for Robert Reebie and Associates, Inc.
(Contract DOT-FR-20065)
(PB-258197/3; FRA/OPPD-76/2.2-Pt-2) Avail: NTIS HC A16/MF A01 CSCL 13F

The manual has been designed to assist intermodal operators to establish the most efficient operating pattern for each local situation. GRA

N77-15934# Pennsylvania State Univ., University Park. Center for the Study of Science Policy.
DIFFUSION OF INNOVATIONS IN MUNICIPAL GOVERNMENTS Executive Summary
Irwin Feller, Donald C. Menzel, and Lee Ann Kozak Jun. 1976 27 p
(Grant NSF DA-74-20621)
(PB-257068/7; NSF/PRA-74-20-1) Avail: NTIS HC A03/MF A01 CSCL 05A

The processes of diffusion in municipal governments were described, and by doing so, the importance of factors which were identified in the theoretical literature as determinants of the diffusion of innovations in organizations was examined. The hypothesis that the creation of a performance gap is a critical factor in shaping public sector receptivity to new technologies was tested. The hypothesis was explored that the observed patterns of adoption of new technologies in the public sector--which are often attributed to the organizational characteristics of given state or local agencies--may in fact reflect the independently determined marketing strategies of the manufacturers of these technologies. GRA

N77-15935# Pennsylvania State Univ., University Park. Center for the Study of Science Policy.
DIFFUSION OF INNOVATIONS IN MUNICIPAL GOVERNMENTS Final Report
Irwin Feller, Donald C. Menzel, and Lee Ann Kozak Jun. 1976 446 p refs
(Grant NSF DA-74-20621)
(PB-257069/5; NSF/PRA-74-20-2) Avail: NTIS HC A19/MF A01 CSCL 05A

The findings of an investigation into the diffusion of technological innovations among line agencies in municipal governments are presented. An attempt to provide an improved understanding of the processes of innovation and diffusion in municipal governments, an improvement in the state of diffusion theory, and a set of recommendations on policies that can be employed to foster the diffusion of innovations in municipal governments are represented. GRA

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

N77-15936 Michigan Univ., Ann Arbor.
LIGHT VARIATIONS OF X-RAY BINARIES Ph.D. Thesis
Larry David Petro 1976 143 p
Avail: Univ. Microfilms Order No. 76-27568

The interpretation of the light variations of the optical primary of an X-ray binary system is presented in terms of a tidal lobe model. This model is a modified version of a Roche lobe model. The effects of asynchronous rotation, radiation pressure, and weak X-ray heating are included. For each star the observations are tabulated as reduced to a uniform system. The presence of unmodeled light variations in each system are discussed. These, rather than the accuracy of the approximate model, limit the accuracy of the derived parameters. The mass ratios found using the tidal lobe model are expected to be ten percent too large. A new mode of light variation in Sk 160 is revealed by observations presented. Dissert. Abstr.

N77-15937 Columbia Univ., New York.
STUDIES DIRECTED TOWARDS THE DETECTION AND INTERPRETATION OF INTRINSIC STELLAR POLARIZATION Ph.D. Thesis
Daniel Patrick Hayes 1976 193 p
Avail: Univ. Microfilms Order No. 76-29319

A detailed broad band B filter linear polarization survey of ten emission line O stars revealed that four of these stars are intrinsically polarized. The results yield important information on the spatial extent and temporal variability of the envelopes associated with these stars. An extensive series of observations revealed that a significant polarization decrease occurs across the H (gamma line of two stars gamma Cas and zeta Tau). These observations have important implications for an understanding of the envelopes associated with these stars. A wide band B filter circular polarization survey of ten binaries and Be stars was carried out. No statistically significant circular polarization was uncovered. Dissert. Abstr.

N77-15938 Columbia Univ., New York.
X-RAY OBSERVATIONS OF TWO LUNAR OCCULTATIONS OF THE CRAB NEBULA Ph.D. Thesis
William Hsin-Min Ku 1976 219 p
Avail: Univ. Microfilms Order No. 76-29324

The X-ray source in the Crab Nebula was observed during two lunar occultations: a 3 November 1974 rocket observation measured the 1.5-20 keV flux distribution from 103 in. W to 9 in. E of the pulsar NP 0532 along a position angle (p.a.) of 255, and a second rocket observation on 28 December 1974 measured the 0.6-22 keV flux distribution from 62 in. W to 63 in. E of the pulsar along p.a. = 300 deg. The combined results of the two scans of the nebula indicate that the spatial distribution of the X-ray flux from the nebula is centered on a region 10 in. to 15 in. NW of the pulsar. Dissert. Abstr.

N77-15939 Yale Univ., New Haven, Conn.
ABUNDANCE DETERMINATIONS OF HALO HORIZONTAL BRANCH STARS Ph.D. Thesis
Stephen Charles Danford 1976 213 p
Avail: Univ. Microfilms Order No. 76-29190

Cassegrain spectra and narrow band photometric colors of likely horizontal branch stars were obtained in order to: (1) isolate a sample of field horizontal branch stars, and (2) study the abundances of elements heavier than hydrogen that are present in the stars. The spectroscopic and photometric data were used to determine stellar temperatures, surface gravities, and metal abundances. Proper account was taken of the effects of metal line blocking on the photometric colors. The stars were identified as horizontal branch stars based on their temperatures, gravities, rotational velocities, metal abundances, and radial velocities. The abundance characteristics of the horizontal branch stars of the halo were discussed. The stars show a mean abundance of 0.10 solar, with only a small number of stars displaying abundances much greater or less than this. Dissert. Abstr.

N77-15940 Michigan Univ., Ann Arbor.
YTTRIUM IN THE PECULIAR A AND B STARS Ph.D. Thesis
Marc Stephen Allen 1976 98 p
Avail: Univ. Microfilms Order No. 76-27433

Spectroscopic analysis of 18 late B and early A stars was conducted using 2.4 A/mm blue plate region spectra obtained at the Dominion Astrophysical Observatory. The physical characteristics of the stellar atmospheres were determined and abundances calculated for iron, strontium, yttrium, and zirconium with an LTE spectrum synthesis algorithm. Included in the sample were nine mercury-manganese stars; for some of these, previous studies indicated abundance excesses of yttrium over both strontium and zirconium in violation of the systematics of neutron-addition nucleosynthesis. No such anomalous excess was expected for the nine control stars, which included normal, Am, and Ap spectrum variable stars. Dissert. Abstr.

N77-15941*# Scientific Translation Service, Santa Barbara, Calif.
ASTRONOMICAL TIME (DETERMINATIONS, CALCULATION SYSTEMS, TRANSFORMATION ALGORITHMS)
R. R. Nazirov Washington NASA Oct. 1976 42 p refs Transl. into ENGLISH of "Astronomicheskoye Vremy (Opredeleniya, Sistemy Ischisleniya, Algoritmy Perekhoda)", Acad. Sci. USSR, Inst. of Space Res., Moscow, report PR-260, 1976 p 1-41
(Contract NASw-2791)
(NASA-TT-F-17269; PR-260) Avail: NTIS HC A03/MF A01 CSCL 03A

Universal, sidereal and ephemeris time are discussed. The systems of computation for these times are determined. Transformation formulas are presented from one astronomical time to another and from one computation system to another. The subprogram complex TIME, described in this work, is a part of a system of programs in the Fortran language designed to perform navigational calculations on the BESM-6 and ES Ryad computers. Author

N77-15942*# National Aeronautics and Space Administration, Washington, D.C.
THE SUPERNOVA: A STELLAR SPECTACLE
W. C. Straka (Jackson State Univ., Miss.) Sep. 1976 43 p refs Prepared in cooperation with Am. Astron. Soc.; and NSF
(NASA-EP-126) Avail: NTIS MF A01; SOD HC $1.30 as NAS 1.19:126 CSCL 03A

The life of a star, the supernova, related objects and their importance in astronomy and science in general are discussed. Written primarily for science teachers of secondary school chemistry, physics, and earth sciences, the booklet contains a glossary, reference sources, suggested topics for discussion, and projects for individual or group assignment. Author

N77-15943*# National Aeronautics and Space Administration, Washington, D.C.
ATOMS IN ASTRONOMY
Paul A. Blanchard Sep. 1976 39 p refs Sponsored in part by American Astronomical Society and NSF
(NASA-EP-128) Avail: NTIS MF A01; SOD HC $1.20 CSCL 03A

Aspects of electromagnetic radiation and atomic physics needed for an understanding of astronomical applications are explored. Although intended primarily for teachers, this brochure is written so that it can be distributed to students if desired. The first section, Basic Topics, is suitable for a ninth-grade general science class; the style is simple and repetitive, and no mathematics or physics background is required. The second section, Intermediate and Advanced Topics, requires a knowledge of the material in the first section and assumes a generally higher level of achievement and motivation on the part of the student. These latter topics might fit well into junior-level physics, chemistry, or earth-science courses. Also included are a glossary, a list of references and teaching aids, class exercises, and a question and answer section. Author

N77-15944*# National Aeronautics and Space Administration, Washington, D.C.
EXTRAGALACTIC ASTRONOMY: THE UNIVERSE BEYOND OUR GALAXY
Kenneth Charles Jacobs Sep. 1976 43 p refs Sponsored in part by NSF
(NASA-EP-129) Avail: NTIS MF A01; SOD HC $1.30 as NAS 1.19:129 CSCL 03A

This single-topic brochure is for high school physical science teachers to use in introducing students to extragalactic astronomy. The material is presented in three parts: the fundamental content of extragalactic astronomy; modern discoveries delineated in greater detail; and a summary of the earlier discussions within the structure of the Big-Bang Theory of evolution. Each of the three sections is followed by student exercises (activities, laboratory projects, and questions-and-answers). The unit close with a glossary which explains unfamilar terms used in the text and a collection of teacher aids (literature references and audiovisual materials for utilization in further study). Author

N77-15945*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COORDINATED X-RAY OPTICAL AND RADIO OBSERVATIONS OF YZ CANIS MINORIS
Judith T. Karpen, Carol J. Crannell, R. W. Hobbs, S. P. Maran, T. J. Moffett (Purdue Univ.), D. Bardas (MIT, Cambridge), G. W. Clark (MIT, Cambridge), D. R. Hearn (MIT, Cambridge), F. K. Li (MIT, Cambridge), T. M. Markert (MIT, Cambridge) et al Dec. 1976 42 p refs
(Contract NAS5-11450; Grants NGL-21-002-033; NGR-21-002-199; NsG-7167; NSF AST-75-03977; NSF DES-73-06559; NSF GA-31676)
(NASA-TM-X-71256; X-682-76-287) Avail: NTIS HC A03/MF A01 CSCL 03A

Coordinated X-ray, optical, and radio observations of the flare star YZ CMi are reported. Twenty-two minor optical flares and twelve radio events were recorded. No major optical flares, greater than 3 magnitudes, were observed. Although no flare related X-ray emission was observed, the measured upper limits in this band enable meaningful comparisons with published flare star models. Three of the five models predicting the relative X-ray to optical or radio flare luminosities are in serious disagreement with the observations. For the largest optical flare with coincident X-ray coverage, the 3 sigma upper limit on X-ray emission in the 0.15 to 0.8 keV band is 8.7 x 10 to the 28th power erg/s, corresponding to a ratio of X-ray to B-band luminosity of less than 0.3. Based on the present results, the contribution of the flares UV Ceti flare stars to the galactic component of the diffuse soft X-ray background is less than 0.2 percent. Author

90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

N77-15946 Case Western Reserve Univ., Cleveland, Ohio.
THE MICROSCALE OF THE INTERSTELLAR MEDIUM FROM POLARIMETRY OF DOUBLE STARS Ph.D. Thesis
Anthony James Weitenbeck 1976 46 p
Avail: Univ. Microfilms Order No. 76-28427

Polarimetry in the visual wavelength region was presented for 63 stars in 31 wide physical double and multiple star systems. Evidence was found indicating possible time changes in polarization for the stars HR 1161 and theta 2 Ori B. For separations less than about 10,000 AU, the differences in polarization parameters between the stars in a pair were of the order of the observational uncertainties. This allows a lower limit of about 10,000 AU to be placed on the microscale, where the term microscale is defined as the characteristic separation over which changes of .0010 or greater in the polarization parameters are observed. Dissert. Abstr.

N77-15947 New York State Univ., Albany.
THE RADIO EVOLUTION OF YOUNG SUPERNOVA REMNANTS Ph.D. Thesis
Richard Charles Shirkey, Jr. 1976 143 p
Avail: Univ. Microfilms Order No. 76-28286

A one dimensional spherically symmetric magnetohydrodynamic code was developed to describe the evolution of the

dynamical and radio properties of young supernova remnants. The code contains subroutines which treat the development of Rayleigh-Taylor instabilities wherever they arise in the remnant. Under the assumption of quasi-stationary equilibrium, it was determined that the velocity of the instability was W is approximately (a lambda)1/2, where a is the Rayleigh-Taylor acceleration and lambda is the wavelength of the instability. Subsequent processing of the kinetic energy of expansion, through turbulence, resulted in an increase in temperature and magnetic field strength. The model was used to analyze instability effects of density inhomogeneities in the interstellar medium on magnetic field amplification. Dissert. Abstr.

N77-15948 Wisconsin Univ., Madison.
THE POLARIZATION BY DUST IN THE ORION NEBULA Ph.D. Thesis
Francis Hubert Schiffer, III 1976 74 p
Avail: Univ. Microfilms Order No. 76-20691

The properties of the dust in the Orion Nebula were investigated, where the optical continuum is partially composed of starlight scattered by the dust. The characteristics of this scattered starlight are determined by the characteristics of the dust which did the scattering. From the properties of the scattered starlight, limits on the properties of the dust were derived. Dissert. Abstr.

N77-15949 Yale Univ., New Haven, Conn.
THE EFFECT OF A BRANS-DICKE COSMOLOGY UPON STELLAR EVOLUTION AND THE EVOLUTION OF GALAXIES Ph.D. Thesis
Michael John Prather 1976 213 p
Avail: Univ. Microfilms Order No. 76-29179

The effect which a variable G cosmology, such as Brans-Dicke, will have on the evolution of individual stars and of galaxies composed of these stars was examined in the hope that present day observation of globular clusters or giant elliptical galaxies will provide a test for the Brans-Dicke theory. The higher value of the gravitational coupling coefficient G in the past history of various Brans-Dicke universes was studied in detail. A low density, open universe was selected for study: fractional closure density = 0.2, present Hubble constant = 55 km/s/Mpc, stellar formation at a redshift of 5, and the Brans-Dicke parameter omega = 6. In this universe a set of stellar evolutionary tracks was computed from the Zero-Age Main Sequence through the Giant Branch to the Horizontal Branch for approximately solar composition, (Y,Z) = (0.25, 0.02). Dissert. Abstr.

N77-15950 Texas Univ., Austin.
A STUDY OF VAN DER WAALS BROADENING FOR LINES OF ASTROPHYSICAL INTEREST Ph.D. Thesis
Carl-Heinz Paul Michelis 1976 395 p
Avail: Univ. Microfilms Order No. 76-26674

When the perturber is atomic hydrogen the Van Der Waals interaction constant C6 can be determined exactly for both the ground and excited states of the perturbed atom. A computational method was developed which allows the calculations to be carried out in a systematic and time saving manner. Using this method, interaction constants were computed for 14 energy levels of Na I which gave rise to all of the Na I lines in the visible region of the solar spectrum, as well as the levels of some selected Mg I and Ca II lines. The results were compared to those obtained using the most commonly employed Coulomb-approximation methods. Both methods gave nearly identical results for highly excited states, but for the lowest levels, the exact method yields answers which were systematically smaller, amounting to a maximum difference of 20% for the ground state of Na I. A further comparison of C6 for the ground state of Na I to the value derived by Dalgarno using his One-Center method, the only other exact method known, shows excellent agreement. Dissert. Abstr.

N77-15951 Maryland Univ., College Park.
GALACTIC STRUCTURE AND KINEMATICS IN THE CENTAURUS REGIONS OF THE MILKY WAY Ph.D. Thesis
Peter Douglas Jackson 1976 315 p
Avail: Univ. Microfilms Order No. 76-27396

Observations were made of luminous OB stars and of the 21-cm line of neutral hydrogen in the direction of the Southern Milky Way constellation Centaurus. The optical observations were carried out at the Cerro Tololo Interamerican Observatory, in Chile, and the radio observations were carried out at the Instituto Argentino de Radioastronomia, in Argentina. Distances and interstellar reddening were determined for the 166 stars judged to be free of emission in the H beta line. In order to perform these calculations as accurately as possible, the author made a preliminary calibration of absolute magnitude as a function of H beta index and intrinsic color. For the kinematic study: (1) radial velocities, accurate to + or - 5 km/sec, were measured for 17 of the OB stars in the longitude ranges 305 deg to 309 deg and 313 deg to 317 deg and (2) the 21 cm line was observed for the longitude range 305 deg to 309 deg and the data presented in the form of contour maps of constant latitude, longitude, and radial velocity. Dissert. Abstr.

N77-15952*# Kanner (Leo) Associates, Redwood City, Calif.
ECLIPSES OF THE IK-3 SATELLITE
Francis Link Jan. 1977 5 p refs Transl. into ENGLISH from Compt. Rend., Series B - Sci. Phys. (France), vol. 282, no. 17, 3 May 1976 p 415-416
(Contract NASw-2790)
(NASA-TT-F-17311) Avail: NTIS HC A02/MF A01 CSCL 03B

Photometric measurements of the eclipses of the Soviet satellite IK-3 show, on the one hand, geographic distribution of ozone, and, on the other, absorption by meteoric aerosols linked to the meteor showers of Orionids and Geminids. Author

N77-15953*# National Aeronautics and Space Administration, Washington, D.C.
CHEMISTRY BETWEEN THE STARS
Richard H. Gammon (Natl. Radio Astronomy Obs., Charlottesville, Va.) Sep. 1976 63 p refs Prepared in cooperation with Am. Astron. Soc.
(NASA-EP-127) Avail: NTIS MF A01; SOD HC $1.60 as NAS 1.19:127 CSCL 03B

A unit is presented for the secondary school teacher of physics, chemistry, astronomy, or earth sciences. Included are a list of reference materials, teaching aids, and projects. Discussion questions and a glossary are also provided. Concepts developed are: the nature of interstellar space, spectroscopy, molecular signals from space and interstellar molecules and other areas of astronomy. Author

N77-15954*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TELESCOPES AND SPACE EXPLORATION
John C. Brandt and Stephen P. Maran [1976] 17 p Original contains color illustrations
(NASA-TM-X-74275) Avail: NTIS HC A02/MF A01 CSCL 03B

The necessity for different types of telescopes for astronomical investigations is discussed. Major findings in modern astronomy by ground-based and spaceborne telescopes are presented. Observations of the Crab Nebula, solar flares, interstellar gas, and the Black Hole are described. The theory of the oscillating universe is explored. Operating and planned telescopes are described. A.H.

N77-15955*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SYMPOSIUM ON RECENT RESULTS IN INFRARED ASTROPHYSICS
Palmer Dyal, ed. Jan. 1977 84 p refs Symp. held at Moffett Field, Calif., Jan. 1977
(NASA-TM-X-73190; A-6856) Avail: NTIS HC A05/MF A01 CSCL 03B

Abstracts of papers presented at a symposium titled Recent Results in Infrared Astrophysics are set forth. The abstracts emphasize photometric, spectroscopic, polarization, and theoretical results on a broad range of current topics in infrared astrophysics. Author

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design see *18 Spacecraft Design Testing, and Performance.* For space stations see *15 Launch Vehicles and Space Vehicles.*

N77-15956 Arizona Univ., Tucson.
THE STRUCTURE OF THE PLANETS JUPITER AND SATURN Ph.D. Thesis
Wayne Lewis Slattery 1976 62 p
Avail: Univ. Microfilms Order No. 76-28197

Planetary models for Jupiter and Saturn were computed using a fourth order theory and a new molecular equation of state. The equation of state for the molecular hydrogen and helium planetary envelopes was calculated using a Monte Carlo technique. Models for Jupiter were found that have a small amount of heavy elements either mixed with hydrogen and helium throughout the interior of the planet or concentrated in a small dense core. Saturn was modeled with a solar composition hydrogen and helium envelope and a small dense core. The molecular equation of state linked with suitable interior equations of state can produce Jovian models which satisfy the observational data. The planetary models show that the enrichment of heavy elements (relative to solar composition) was approximately three times for Jupiter and ten times for Saturn. Dissert. Abstr.

N77-15957 Arizona Univ., Tucson.
LIGHT SCATTERING PROPERTIES OF JUPITER'S RED SPOT Ph.D. Thesis
Lyn Richard Doose 1976 151 p
Avail: Univ. Microfilms Order No. 76-28213

The intensity and linear polarization of sunlight scattered by Jupiter's Red Spot and surrounding regions were measured in blue light with the imaging photopolarimeter on board the Pioneer 10 spacecraft. Two maps, one showing the Red Spot near the planetary limb at 43 deg solar phase angle and another showing the spot near the terminator at 103 deg phase angle, resolved the spot into about 40 and 130 elements, respectively. The intensity and polarization in both blue and red light at 80 deg phase angle were measured by a similar instrument on the Pioneer 11 spacecraft. The Red Spot was resolved into about 40 elements. Dissert. Abstr.

N77-15958 Arizona Univ., Tucson.
CHEMICAL REACTIONS AT THE SURFACE AND IN THE ATMOSPHERE OF VENUS Ph.D. Thesis
Godfrey Theodore Sill 1976 207 p
Avail: Univ. Microfilms Order No. 76-28195

The atmosphere of Venus differs from that of earth: mostly carbon dioxide at a pressure of 100 atm and temperature of 750 K. The temperature pressure profile of the Venus atmosphere is known; certain minor constituents of the atmosphere were identified, both by spectroscopy and by direct sampling conducted by spacecraft. Chemical thermodynamics was employed to determine the relative abundance of various gases in the presence of high temperature, high pressure CO2. The sulfur gases, SO2, COS, H2S, S2, and S8, are all stable in the Venus atmosphere. SO3 is restricted. The pressure of ammonia detected by Venera 8 is compatible with COS and H2S, but it is not compatible with certain partial pressures of SO2 gas and sulfur liquid. Dissert. Abstr.

N77-15959 Arizona State Univ., Tempe.
TOTAL SULFUR CONTENT AND DISTRIBUTION IN THE LUNAR SAMPLES Ph.D. Thesis
Jerry Dale Cripe 1976 182 p
Avail: Univ. Microfilms Order No. 76-27268

The total sulfur content of representative samples from the six Apollo lunar missions was determined using a combustion iodate photometric titration technique. The technique was developed for rock samples of less than 500 mg, with minimum preparation to minimize for possible contamination. Total sulfur abundances were measured in 217 different Apollo lunar basalts, breccias, and fines to characterize the abundance of sulfur in lunar samples. A sampling of 195 terrestrial basalts was measured for comparison. Lunar basalts were 2 to 3 times higher in sulfur content than terrestrial basalts. Dissert. Abstr.

N77-15960*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SURFICIAL GEOLOGY OF MARS: A STUDY IN SUPPORT OF A PENETRATOR MISSION TO MARS
Paul Spudis (Arizona State Univ.) and Ronald Greeley Aug. 1976 58 p refs
(NASA-TM-X-73184; A-6831) Avail: NTIS HC A04/MF A01 CSCL 03B

Physiographic and surficial cover information were combined into unified surficial geology maps (30 quadrangles and 1 synoptic map). The surface of Mars is heterogeneous and is modified by wind, water, volcanism, tectonism, mass wasting and other processes. Surficial mapping identifies areas modified by these processes on a regional basis. Viking I mission results indicate that, at least in the landing site area, the surficial mapping based on Mariner data is fairly accurate. This area was mapped as a lightly cratered plain with thin or discontinuous eolian sediment. Analysis of lander images indicates that this interpretation is very close to actual surface conditions. These initial results do not imply that all surficial units are mapped correctly, but they do increase confidence in estimates based on photogeologic interpretations of orbital pictures. Author

N77-15961*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A GEOLOGICAL BASIS FOR THE EXPLORATION OF THE PLANETS
Ronald Greeley, ed. and Michael H. Carr, ed. (Geological Survey, Menlo Park, Calif.) Washington 1976 117 p refs
(Grant NGR-05-017-037; NASA Order W-13576)
(NASA-SP-417) Avail: NTIS HC A06/MF A01 CSCL 03B

The relevance of planetary geology in relation to the origin and evolution of the solar system and of life is discussed. Stratigraphy, structural geology and geochemistry of planets were examined. For individual titles, see N77-15962 through N77-15967.

N77-15962*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A GEOLOGICAL BASIS FOR THE EXPLORATION OF THE PLANETS: INTRODUCTION
Ronald Greeley and Michael H. Carr (Geological Survey, Menlo Park, Calif.) *In its* A Geol. Basis for the Exploration of the Planets 1976 p 1-12 refs (For primary document see N77-15961 06-91)
Avail: NTIS HC A06/MF A01 CSCL 03B

The geological aspects of solar-system exploration were considered by first showing how geologic data are related to space science in general, and, second, by discussing the approach used in planetary geology. The origin, evolution, and distribution of matter condensed in the form of planets, satellites, comets, and asteroids were studied. Terrestrial planets, comets, and asteroids, and the solid satellites of the outer planets are discussed. Jupiter and Saturn, in particular, have satellites of prime importance. Geophysics, geochemistry, geodesy, cartography, and other disciplines concerned with the solid planets were all included. S.M.

N77-15963*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
STRATIGRAPHY AND STRUCTURAL GEOLOGY
M. H. Carr (Geological Survey, Menlo Park, Calif.), D. E. Wilhelms (Geological Survey, Menlo Park, Calif.), R. Greeley, and J. E. Guest (London Univ. Observatory) *In its* A Geol. Basis for the Exploration of the Planets 1976 p 13-32 refs (For primary document see N77-15961 06-91)
Avail: NTIS HC A06/MF A01 CSCL 03B

The immediate goal of stratigraphy and structural geology is to reduce the enormous complexity of a planetary surface to comprehensible proportions by dividing the near-surface rocks into units and mapping their distribution and attitude. Author

N77-15964*# Geological Survey, Menlo Park, Calif.
GEOCHEMISTRY

M. H. Carr and P. Toulmin, III (Geological Survey, Washington) *In* NASA Ames Res. Center A Geol. Basis for the Exploration of the Planets 1976 p 33-62 refs (For primary document see N77-15961 06-91)
Avail: NTIS HC A06/MF A01 CSCL 03B

The most effective strategy for the geochemical study of a planet is to proceed systematically with the mineralogical and chemical characterization of its materials in accordance with geologically determined priorities. It is insufficient merely to analyze chemically the surface rocks. To appreciate the meaning of a chemical analysis, some assessment must be made of the geologic history of the sample - what its source and mode of origin are and what processes have operated upon the sample to cause chemical fractionation. Determination of mineralogy, texture, lithology, and other properties of the rock that might be relevant to origin is, therefore, necessary. Author

N77-15965*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
GEOPHYSICS
M. H. Carr (Geological Survey, Menlo Park, Calif.) and P. Cassen *In its* A Geol. Basis for the Exploration of the Planets 1976 p 63-74 refs (For primary document see N77-15961 06-91)
Avail: NTIS HC A06/MF A01 CSCL 03B

Four areas of investigation, each dealing with the measurement of a particular geophysical property, are discussed. These properties are the gravity field, seismicity, magnetism, and heat flow. All are strongly affected by conditions, past or present, in the planetary interior; their measurement is the primary source of information about planetary interiors. Author

N77-15966*# Geological Survey, Flagstaff, Ariz.
GEODESY AND CARTOGRAPHY
R. Batson and D. Arthur *In* NASA Ames Res. Center A Geol. Basis for the Exploration of the Planets 1976 p 75-84 refs (For primary document see N77-15961 06-91)
Avail: NTIS HC A06/MF A01 CSCL 03B

Geodesy and cartography provide the geometric framework on which most investigations of planets are ultimately based. Specifically, the products of these disciplines provide information on the following: (1) the dimensions of the planet, (2) a mathematical figure of reference for the planet, (3) the orientation of the body in the celestial coordinate system, (4) the rotational constants, (5) a defined system of coordinates, (6) the location of surface points in the defined coordinate system, (7) the gravity potential expressed in spherical harmonics, (8) topographic and thematic maps, and (9) surface albedo in various wavelengths. The relevance of geodesy and cartography to planetology is discussed, and the requirements of data acquisition and mission design are considered. Author

N77-15967*# National Aeronautics and Space Administration, Washington, D.C.
EARTH-BASED STUDIES
S. Dwornik *In its* A Geol. Basis for the Exploration of the Planets 1976 p 85-106 refs (For primary document see N77-15961 06-91)
Avail: NTIS HC A06/MF A01 CSCL 03B

Theoretical understanding of geologic processes of all planets and satellites is the ultimate goal of comparative geologic studies, simply because it is not possible to sample and study all bodies in the solar system in situ. Theories must make verifiable predictions, be able to test the aptness of terrestrial analogs, and ultimately should provide direction for future planetary research. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

N77-15968 California Univ., Riverside.
A SEARCH FOR SOLAR NEUTRONS FROM 10 TO 100 MeV Ph.D. Thesis
Shin Haeng Moon 1976 115 p
Avail: Univ. Microfilms Order No. 76-28074

Three separate balloon flights were made to measure the solar neutrons with a telescope consisting of two 5000 sq. cm. liquid scintillator detectors spaced 100 cm apart using double scattering and time of flight technique. The first and second measurements were made 40 deg N geomagnetic latitude, from balloons on September 26, 1971 and May 14, 1972. The third balloon flight was made at Cape Giradeau, Missouri, 45 deg N geomagnetic latitude, on September 19, 1972. The primary cosmic rays and secondary atmospheric charged particles were eliminated by an anticoincidence shield of plastic scintillator. The gamma rays were excluded in the data analysis by their relativistic time of flight. Dissert. Abstr.

N77-15969 Pennsylvania State Univ., University Park.
BIPOLAR MAGNETIC FIELD REGIONS AND SOLAR MICROWAVE BURSTS Ph.D. Thesis
Neal Kenton Baker 1975 238 p
Avail: Univ. Microfilms Order No. 76-26819

A solar microwave burst was modeled with non-thermal electrons trapped in a mirror region in a bipolar sunspot group. The electrons were trapped in an arc and oscillated between two mirror points with a period of three to five seconds. This arc resembled the X-ray loop structure connecting the sunspots of an active region. The model was applied to five microwave bursts to determine the energies of the electrons and the value of the mirror point field. The bursts selected for study met these criteria: (1) the burst had to occur within 30 deg of central meridian; (2) the burst had to have been observed at a number of frequencies; (3) the burst had to be free of other events; and (4) accurate records of the burst had to be available. The theoretical model was calculated on an IBM 370/model 168 computer. Dissert. Abstr.

N77-15970*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ENHANCEMENT OF SOLAR HEAVY NUCLEI AT HIGH ENERGIES IN THE 4 JULY 1974 EVENT
David L. Bertsch and Donald Reames Dec. 1976 16 p refs Submitted for publication
(NASA-TM-X-71258; X-662-76-293) Avail: NTIS HC A02/MF A01 CSCL 03B

Relative abundances of energetic nuclei in the 4 July 1974 solar event are presented. The results show a marked enhancement of abundances that systematically increase with nuclear charge numbers in the range of the observation, 6 less than or equal to Z less than or equal to 26 for energies above 15 MeV/nucleon. While such enhancements are commonly seen below 10 MeV/nucleon, most observations at higher energies are found to be consistent with solar system abundances. The energy spectrum of oxygen is observed to be significantly steeper than most other solar events studied in this energy region. It is proposed that these observations are characteristic of particle populations at energies approximately 1 MeV/nucleon, and that the anomalous features observed here may be the result of the high energy extension of such a population that is commonly masked by other processes or populations that might occur in larger solar events. Author

N77-15971*# Teledyne Brown Engineering, Huntsville, Ala. Systems Analysis Dept.
RESEARCH IN SOLAR PHYSICS Final Report
William Henze 30 Sep. 1976 42 p refs
(Contract NAS8-26442)
(NASA-CR-150157) Avail: NTIS HC A03/MF A01 CSCL 03B

Results from research in solar physics related to the Skylab/ATM S-056 X-Ray Experiment are presented. Included is a description of the data obtained by the X-Ray Telescope. Also presented are the S-056 filter bandpasses, the point-spread function, the meaning or interpretation of broadband filter observations, and reports on the analysis of some of the solar observations. Author

93 SPACE RADIATION

Includes cosmic radiation and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N77-15972 Maryland Univ., College Park.
HADRON-IRON INELASTIC CROSS SECTIONS FROM 100 Gev TO 2000 Gev AND THE COMPOSITION OF THE COSMIC RAY FLUX AT 2900 METERS Ph.D. Thesis
James Russell MacFall 1976 292 p
Avail: Univ. Microfilms Order No. 76-28695

An experiment performed to study the interactions of unaccompanied cosmic ray hadrons in an iron calorimeter at an altitude of 2900 meters was described near Sunspot, New Mexico. Wide-gap optical spark chambers in the calorimeter determined, for each event, the depth interval of iron in which the first interaction occurred. The distribution of first interaction depth was used to determine the hadron-iron inelastic cross section for energies, as measured by the calorimeter, from 100 Gev to 2000 Gev. The cross section was observed to rise from (677 + or - 25)mb at 134 Gev to (798 + or - 19)mb at 1270 Gev. The charged-pion-to-proton ratio of the incident flux of hadrons unaccompanied over 3.3 sq m with energies between 400 Gev and 2000 Gev was measured using a transition radiation detector. Dissert. Abstr.

N77-15973*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE COSMIC FAR-INFRARED BACKGROUND AT HIGH GALACTIC LATITUDES
F. W. Stecker, J. L. Puget (Observatoire de Paris-Meudon), and G. G. Fazio (Center for Astrophysics) Dec. 1976 16 p refs Submitted for publication
(NASA-TM-X-71254; X-602-76-274) Avail: NTIS HC A02/MF A01 CSCL 03B

Far-infrared background fluxes from various cosmic sources are predicted. These fluxes lie near the high frequency side of the blackbody radiation spectrum. These sources could account for a significant fraction of the background radiation at frequencies above 400 GHz which might be misinterpreted as a comptonization distortion of the blackbody radiation. Particular attention is paid to the possible contributions from external galaxies, rich clusters of galaxies and from galactic dust emission. Author

99 GENERAL

No abstracts in this category.

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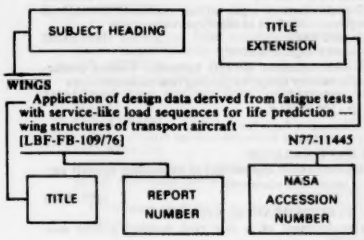

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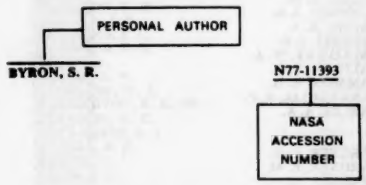

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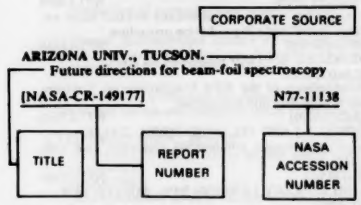

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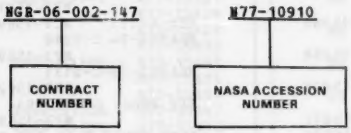

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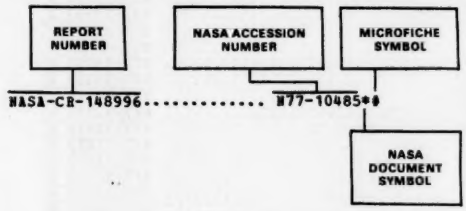

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MRL-R-667 ..... N77-15190 #
MRL-R-671 ..... N77-15094 #
MRL-R-674 ..... N77-15104 #
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MRL-TN-371 ..... N77-15211 #
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NASA-CASE-ARC-11035-1 ..... N77-15621*#
NASA-CASE-ARC-11058-1 ..... N77-15641*#

NASA-CASE-GSC-11883-2 ..... N77-15400*#

NASA-CASE-HQN-10887-1 ..... N77-15293*#

NASA-CASE-KSC-11004-1 ..... N77-15618*#
NASA-CASE-KSC-11010-1 ..... N77-15493*#
NASA-CASE-KSC-11030-1 ..... N77-15617*#
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NASA-CASE-LAR-11852-1 ..... N77-15027*#
NASA-CASE-LAR-11898-1 ..... N77-15103*#
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NASA-CASE-LAR-12016-1 ..... N77-15236*#
NASA-CASE-LAR-12181-1 ..... N77-15192*#

NASA-CASE-LEW-12185-1 ..... N77-15490*#
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NASA-CASE-MFS-23506-1 ..... N77-15105*#

NASA-CASE-MSC-16043-1 ..... N77-15397*#
NASA-CASE-MSC-16100-1 ..... N77-15233*#

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NASA-CR-2786 ..... N77-15344*#
NASA-CR-135074 ..... N77-15038*#
NASA-CR-135095 ..... N77-15492*#
NASA-CR-135113 ..... N77-15101*#
NASA-CR-135114 ..... N77-15488*#
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NASA-CR-135123 ..... N77-15792*#
NASA-CR-135130 ..... N77-15381*#
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NASA-CR-137927 ..... N77-15008*#
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NASA-CR-141414 ..... N77-15585*#
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NASA-CR-144846 ..... N77-15062*#
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NASA-CR-151150 ..... N77-15291*#
NASA-CR-151152 ..... N77-15080*#
NASA-CR-151153 ..... N77-15077*#
NASA-CR-151154 ..... N77-15620*#
NASA-CR-151155 ..... N77-15644*#
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NASA-TM-X-71254 ..... N77-15973*#
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NASA-TM-X-73546 ..... N77-15487*#
NASA-TM-X-73558 ..... N77-15056*#
NASA-TM-X-73581 ..... N77-15037*#
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NASA-TT-F-17346 ..... N77-15871*#
NASA-TT-F-17347 ..... N77-15292*#

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NASA-TT-F-17365 ..... N77-15129*#
NASA-TT-F-17370 ..... N77-15346*#
NASA-TT-F-17371 ..... N77-15872*#
NASA-TT-F-17372 ..... N77-15119*#
NASA-TT-F-17373 ..... N77-15580*#
NASA-TT-F-17377 ..... N77-15130*#
NASA-TT-F-17387 ..... N77-15642*#
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NIH-NO1-HV-4-2909-3 ..... N77-15631 #
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NOAA-TM-ERL-WPL-14 ..... N77-15593 #

NOAA-TM-NESS-77 ..... N77-15376 #
NOAA-TM-NESS-78 ..... N77-15604 #

NOAA-TM-NWS-EDL-14 ..... N77-15011 #

NOAA-TR-EDS-14 ..... N77-15592 #

NOAA-76051902 ..... N77-15569 #
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NOAA-76060806 ..... N77-15570*#
NOAA-76060807 ..... N77-15571 #
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NOAA-76080316 ..... N77-15591 #
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NSF/RDA-74/13/1 ..... N77-15909 #
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OWRT-B-067-NC(2) ..... N77-15914 #

OWRT-C-5184(4208)(4) ..... N77-15479 #

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PAS-76-5 ..... N77-15512 #

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PB-247916-54 ..... N77-15571 #
PB-247916-56 ..... N77-15569 #
PB-256031/6 ..... N77-15909 #
PB-256032/4 ..... N77-15910 #
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PB-256683/4 ..... N77-15526 #
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PB-256793/1 ..... N77-15576 #
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